Proceedings of the Zoological Institute RAS
Vol. 315, No. 2, 2011, pp. 101–132

УДК 568.132:56(116)(5)

NEW ASIATIC MATERIALS ON TURTLES OF THE FAMILY ADOCIDAE WITH A REVIEW OF THE ADOCID RECORD IN ASIA

I.G. Danilov[1]*, V.B. Sukhanov[2] and E.V. Syromyatnikova[1]

[1]*Zoological Institute of the Russian Academy of Sciences, Universitetskaya Emb. 1, 199034 Saint Petersburg, Russia; e-mail: igordanilov72@gmail.com, esyromyatnikova@gmail.com*

[2]*Borissyak Paleontological Institute of the Russian Academy of Sciences, Profsoyuznaya 123, 117997 Moscow, Russia*

ABSTRACT

This paper presents a review of all known records of turtles of the family Adocidae in Asia, including data from 88 localities. New records of adocids (cf. "*Adocus*" *orientalis*, "*Adocus*" sp. indet. 1 & 2, *Adocus* sp. indet. 1–4, *Shachemys ancestralis, Shachemys* sp. indet. 1–5, Adocidae indet.) are described from 14 Cretaceous and Paleogene localities of China, Kazakhstan, Mongolia, Tajikistan and Uzbekistan. Among them the records of Adocidae ("*Adocus*") in the Oligocene of Kazakhstan and China are reported for the first time. Reassessment of the published records allows us to change taxonomic status of previous findings from 16 localities. The previously mentioned materials of "*Adocus*" *orientalis* from the Upper Eocene of Mongolia are described in detail for the first time. *Shineusemys plana* and *Adocoides amtgai* are considered here as species of the genus *Adocus*, and *Mlynarskiella mariani* – as Shachemydinae indet.

Key words: Adocidae, Asia, Cretaceous, Paleogene, turtles

НОВЫЕ АЗИАТСКИЕ МАТЕРИАЛЫ ПО ЧЕРЕПАХАМ СЕМЕЙСТВА ADOCIDAE С ОБЗОРОМ НАХОДОК АДОЦИД В АЗИИ

И.Г. Данилов[1]*, В.Б. Суханов[2] и Е.В. Сыромятникова[1]

[1]*Зоологический институт Российской академии наук, Университетская наб. 1, 199034 Санкт-Петербург, Россия; e-mail: igordanilov72@gmail.com, esyromyatnikova@gmail.com*

[2]*Палеонтологический институт им. А.А. Борисяка Российской академии наук, Профсоюзная ул. 123, 117997 Москва, Россия*

РЕЗЮМЕ

В статье представлен обзор всех известных находок черепах семейства Adocidae в Азии, включающий данные из 88 местонахождений. Описываются новые находки Adocidae (cf. "*Adocus*" *orientalis*, "*Adocus*" sp. indet. 1 & 2, *Adocus* sp. indet. 1–4, *Shachemys ancestralis, Shachemys* sp. indet. 1–5, Adocidae indet.) из 14 меловых и палеогеновых местонахождений Китая, Казахстана, Монголии, Таджикистана и Узбекистана. Среди них находки Adocidae ("*Adocus*") в олигоцене Казахстана и Китая указываются впервые. Пересмотр опубликованных данных позволяет нам изменить таксономический статус прежних находок из 16 местонахождений. Ранее указанные материалы по "*Adocus*" *orientalis* из верхнего эоцена Монголии детально описываются впервые. *Shineusemys plana* и *Adocoides amtgai* рассматриваются здесь в составе рода *Adocus*, а *Mlynarskiella mariani* – как Shachemydinae indet.

Ключевые слова: Adocidae, Азия, мел, палеоген, черепахи

* Corresponding author / Автор-корреспондент.

INTRODUCTION

Adocidae Cope, 1870 are a group of freshwater cryptodiran turtles, known mainly from the Cretaceous and Paleogene of Asia and North America, that are characterized by peculiar shell sculpturing and some other characters (see below; Hutchison 2000; Sukhanov 2000). According to modern phylogenetic studies, adocids are united in the clade Adocusia Danilov et Parham, 2006 (corresponds to ICZN taxon Adocoidea Cope, 1870) together with Nanhsiungchelyidae Yeh, 1966, known only from the Cretaceous of Asia and North America and characterized by a combination of aquatic and terrestrial features (see Danilov and Syromyatnikova 2009a, b). Asiatic record of the Nanhsiungchelyidae was reviewed recently by Danilov and Syromyatnikova (2008), who presented data, including new materials, from 37 localities. One more nanhsiungchelyid record missed from this publication is an undetermined shell fragment of "Schildkröte A" from "Shantung. Lai-Yang-Hsien. SW 16 li. Chiang-Chün-Ting. SW 1 li." (Wiman 1930, S. 23, 24, Taf. II, figs. 5 and 5a). Additional data on Asian nanhsiungchelyids was published by Rothschild (1991), Currie and Eberth (1993), Hirayama et al. (2009, 2010), Tong and Mo (2010), Nakajima et al. (2011).

Although the adocid record in Asia is generally more complete than that of nanhsiungchelyids, it is also based on numerous fragmentary and/or undescribed materials (see Nessov 1997; Sukhanov 2000), which need proper description and determination. In this paper we give a review of Asiatic record of the Adocidae, including description of new findings and some previously undescribed materials.

One of the important characters of Adocidae is the presence of sculpturing of the shell surface with relatively small and regular grooves and pits or dots (hereinafter – adocid sculpturing; see Fig. 1 for two main types of adocid sculpturing), which usually helps to determinate presence of adocids in assemblages even by small shell fragments. The specimens (shell fragments) described in this paper (see Systematics section) in most cases were diagnosed based on this character (for other diagnostic characters of adocids see publications of Danilov and Syromyatnikova 2008, 2009a, b). Sculpturing with small grooves and pits is characteristic of many adocids and well known (Hay 1908; Khosatzky and Nessov 1977; Narmandakh 1985; Syromyatnikova and Danilov 2009). Sculpturing with small dots is typical for species of *Shachemys* Kuznetsov, 1976 and some species of *Adocus* Cope, 1868 (at least, from the Paleogene of Asia; type of sculpturing of *Adocus* species from the Paleogene of North America is not known to us). These dots represent enlarged openings of canals penetrating external cortex of the shell bone (Nessov and Krasovskaya 1984). In other adocids, these openings are also present, but not enlarged and as a result not easily visible. In the whole, shell bone histology and sculpturing of the shell surface of adocids need a special study.

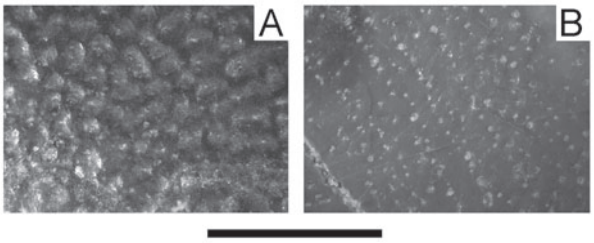

Fig. 1. Two main types of shell sculpturing in adocids: A – *Adocus kizylkumensis* (ZIN PH S78-1); sculpturing with pits; B – *Shachemys baibolatica* (ZIN PH 12/96); sculpturing with dots. Scale bar = 1 cm.

The so called *Adocus* from the Paleogene of Asia is represented by a number of problematic forms which lack an apomorphic character of this genus (overlapping of marginals on to costals). Moreover, these forms show shell sculpturing with small dots (see above) which differs from sculpturing of other Asiatic *Adocus* from the Cretaceous. For this reasons, below we consider *Adocus* from the Paleogene of Asia as "*Adocus*" spp.

New records described in the Systematics section are mostly represented by fragmentary material which does not allow determination below the generic level and does not show any specific differences in morphology. Such records are considered as genus sp. indet.

Anatomical terms of the shell follows Zangerl (1969) and Hutchison and Bramble (1981). Names of localities and formations/svitas are given according to literature data or transliterated from Russian.

Institutional abbreviations. AMNH, American Museum of Natural History, New York, USA; CCMGE, Chernyshev's Central Museum of Geological Exploration, Saint Petersburg, Russia; CNHM, Chongqing Natural History Museum, Chongqing, China; PIN, Borissyak Paleontological Institute of the Russian Academy of Sciences, Moscow, Russia;

ZIN PH, Paleoherpetological collection, Zoological Institute of the Russian Academy of Sciences, Saint Petersburg, Russia; MNHN, Muséum national d'Histoire naturelle, Paris, France.

MATERIAL

In addition to materials described in the Systematics section, our study relies on published data on the following taxa of adocids for comparative purposes: species of *Adocus* Cope, 1868: *A. aksary* Nessov in Nessov et Krasovskaya, 1984 (Syromyatnikova and Danilov 2009); *A. amtgai* Narmandakh, 1985 (Sukhanov 2000; Sukhanov and Narmandakh 2006); *A. annexus* (Hay, 1910) (Hay 1910); *A. bostobensis* Syromyatnikova et Danilov, 2009 (Syromyatnikova and Danilov 2009); *A. dzhurtasensis* Syromyatnikova et Danilov, 2009 (Syromyatnikova and Danilov 2009); *A. foveatus* Nessov et Khosatzky in Khosatzky et Nessov, 1977 (Syromyatnikova and Danilov 2009); "*A*". *kazachstanica* Chkhikvadze, 1973 (Chkhikvadze 1973); *A. kizylkumensis* Nessov, 1981 (Syromyatnikova and Danilov 2009); *A. onerosus* Gilmore, 1919 (Gilmore 1919); "*A*". *orientalis* Gilmore, 1931 (Gilmore 1931); *A.* (orig. *Shineusemys*) *planus* (Sukhanov et Narmandakh, 2006) (Sukhanov 2000; Sukhanov and Narmandakh 2006); *A.* (orig. *Alamosemys*) *substricta* (Hay, 1908) (Hay 1908); species of *Ferganemys* Nessov et Khosatzky, 1977: "*F.*" *itemirensis* Nessov, 1981 (Nessov 1981; Nessov and Krasovskaya 1984; Syromyatnikova, 2011); *F. verzilini* Nessov et Khosatzky, 1977 (Nessov and Khosatzky 1977; Syromyatnikova 2011); *Isanemys srisuki* Tong et al., 2006 (Tong et al. 2006a); *Mlynarskiella mariani* Shuvalov et Ckhikvadze, 1986 (Shuvalov and Chkhikvadze 1986); species of *Shachemys* Kuznetsov, 1976: *Sh. ancestralis* Nessov in Nessov et Krasovskaya, 1984 (Danilov et al. 2007); *Sh. baibolatica* Kuznetsov, 1976 (Danilov et al. 2007); *Sh. laosiana* Lapparent de Broin, 2004 (Lapparent de Broin 2004); *Yehguia* (orig. *Plesiochelys*) *tatsuensis* (Yeh, 1963) (Danilov and Parham 2006).

REVIEW OF RECORDS OF THE ADOCIDAE IN ASIA

The following is a review of 88 records of the adocid turtles in Asia given in alphabetic order of localities. All of these records, except unknown localities (Nos. 87 and 88), are represented in Fig. 2. Some records of adocids published without descriptions, illustrations and any evidences for their systematic assignment. Those of them which we could not examine are marked with an asterisk.

1. Abdurassaj and Syuren'atau, foothills of Chatkal Range, Uzbekistan.

Geology and age. Syuksyuk Formation, Santonian (Nessov 1997).

Material and references. Shell fragments of *Shachemys* sp.* (Nessov 1997, p. 154).

2. Akkurgan, north-eastern Aral Sea area, Kazakhstan.

Geology and age. Bostobe Formation, Santonian – early Campanian (Nessov 1997).

Material and references. Four isolated shell fragments of *Adocus bostobensis* (for review see Syromyatnikova and Danilov 2009, p. 90, fig. 8H, I); shell fragments of *Shachemys baibolatica* (Fig. 3A; Nessov 1997, p. 111).

Remarks. The fragments attributed to *Sh. baibolatica* have typical *Shachemys* sculpturing (with dots) and come from the same formation as type of *Sh. baibolatica*.

3. Akkurgan-Boltyk, north-eastern Aral Sea area, Kazakhstan.

Geology and age. Bostobe Formation, Santonian – early Campanian (Nessov 1997).

Material and references. Shell fragments of *Adocus foveatus** and *Shachemys baibolatica** (Nessov 1997, p. 111).

Remarks. Part of the material described from Akkurgan locality (see above), probably, comes from Akkurgan-Boltyk.

4. Aktau, southern Dzhungar Alatau Ridge, Ili River Basin, Almaty Province, south-eastern Kazakhstan.

Geology and age. ?Aktau Formation, ?Oligocene (see Remarks).

Material. Shell fragments of "*Adocus*" sp. indet. 1, see Systematics section.

Remarks. The age of Aktau is estimated as Middle Eocene – Miocene (Kordikova and Mavrin 1996) or Late Eocene – Late Miocene (Lucas et al. 1997). According to Kordikova and Mavrin (1996), remains of turtles are known there from the Oligocene and Early–Middle Miocene. Thus, it seems most probable that the shell fragments of "*Adocus*" sp. indet. 1 come from the Oligocene.

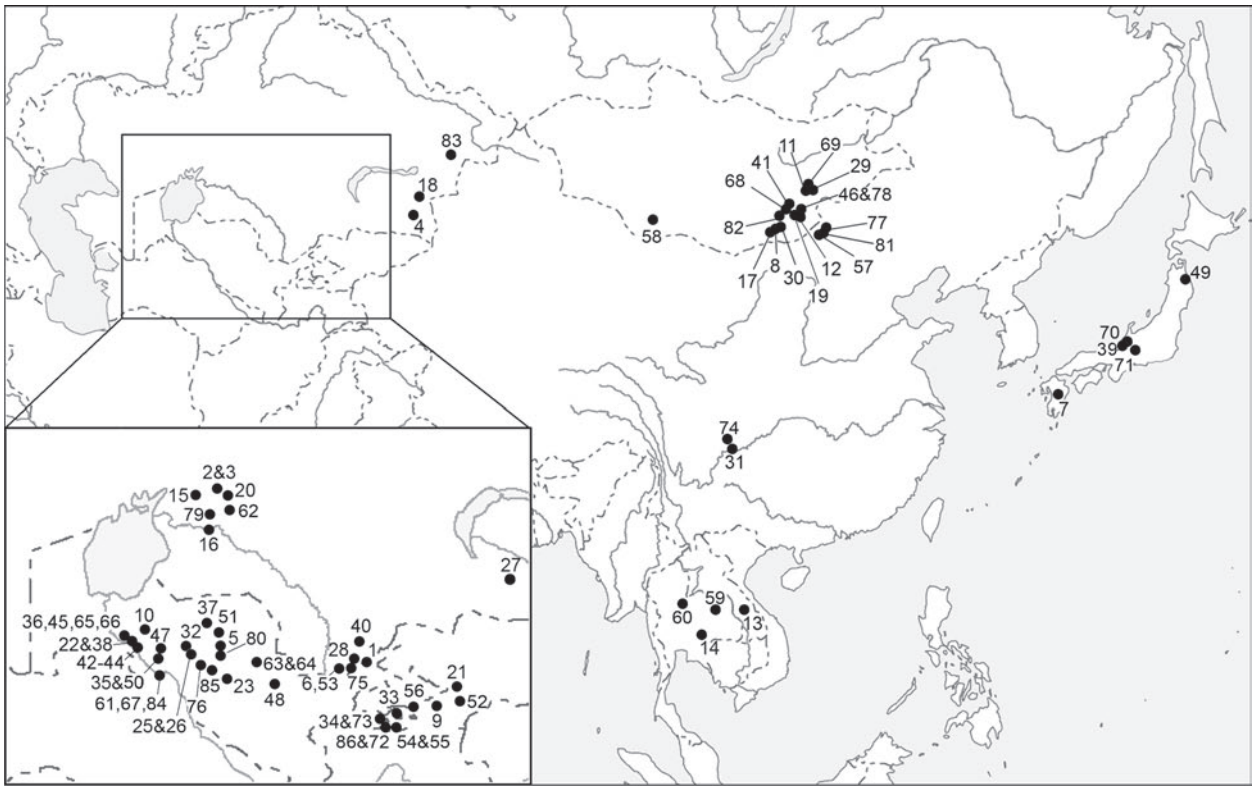

Fig. 2. Map showing all known occurrences of the adocid turtles in Asia: 1 – Abdurassaj & Syuren'atau; 2, 3 – Akkurgan & Akkurgan-Boltyk; 4 – Aktau; 5 – Altyntau; 6 – Alymtau; 7 – Amagimi Dam of Mifune; 8 – Amtgai; 9 – Aravan II; 10 – Ayazkala; 11 – Baga Tarjach; 12 – Bain Shire; 13 – Ban Lam Thoy; 14 – Ban Saphan Hin; 15 – Baybishe; 16 – Baykhozha; 17 – Bayshin Tsav; 18 – Baytuma; 19 – Burkhant; 20 – Buroynak; 21 – Changet IV; 22 – Chelpyk; 23 – Daugyztau I; 25 – Dzharakuduk I; 26 – Dzharakuduk II; 27 – Dzhurtas; 28 – Dzhylga; 29 – Dzun Shakhai; 30 – Ergil Obo; 31 – Gaofengshan; 32 – Itemir; 33 – Kan; 34 – Kansai; 35 – Karachadalisay; 36 – Karakul; 37 – Karamurun II; 38 – Karatepa; 39 – Katsuyama; 40 – Kazgurt; 41 – Khara Khutul; 42 – Khodzhakul I; 43 – Khodzhakul II; 44 – Khodzhakul III; 45 – Khodzhakulsay; 46 – Khongil; 47 – Kokcha I; 48 – Koskuduk; 49 – Kuji; 50 – Kulkala; 51 – Kulkuduk II; 52 – Kylodzhun I; 53 – Kyrkkuduk I; 54 – Kyzylpilyal' I; 55 – Kyzylpilyal' II; 56 – Lyagan; 57 – North Mesa; 58 – Ongon Ulan Ula; 59 – Phu Kum Khao; 60 – Phu Wat; 61 – Pitnyak; 62 – Shakh-Shakh; 63 – Shatyrtyube I; 64 – Shatyrtyube II; 65 – Sheikhdzheili II; 66 – Sheichdzheili III; 67 – Shejh-Aryk; 68 – Shine Us Khuduk; 69 – Shine Usny Tolgod; 70 – Shiramine-mura; 71 – Shokawa; 72 – Shorsu; 73 – Shurab; 74 – Suining; 75 – Syuk-Syuk; 76 – Tamdy-Truba; 77 – Telegraph Line Camp; 78 – Tsagan Teg; 79 – Tyul'keli; 80 – Uch-kuduk; 81 – Urtyn Obo; 82 – Ushyin Khuduk; 83 – Zaisan depression; 84 – Zenge Kurgan III; 85 – Zhaldyrbas Takyr; 86 – Zumuratsho. See text for data on geology, age and material. Unknown localities (87, 88) and locality with uncertain position (24) are not shown.

5. Altyntau (=Aitym), southern Altyntau Range, Central Kyzylkum, Uzbekistan.

Geology and age. ?Late Cretaceous (Nessov 1997).

Material. Fragment of costal of *Shachemys* sp. indet. 1, see Systematics section.

6. Alymtau, Circum-Tashkent Chul, Kazakhstan.

Geology and age. Syuksyuk Formation, Santonian (Nessov 1997).

Material and references. One undetermined shell fragment of *Shachemys* sp. (Fig. 3B; as Adocidae indet.; Nessov 1997, p. 107).

Remarks. This fragment is assigned to *Shachemys* based on surface sculpturing with small dots.

7. Amagimi Dam of Mifune, Kumamoto Prefecture, Kyushu, Japan.

Geology and age. Mifune Group, Coniacian – Santonian (Hirayama 1998; pers. comm. to IGD 2007).

Material and references. 38 shell fragments of *Adocus* sp. (Hirayama 1998, p. 86, pl. 1, figs a–e, h–m); one shell fragment of *Shachemys* sp. (Hirayama 1998, p. 87, pl. 1, figs f, g).

8. Amtgai (=Amtgai Khuduk), Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Bainshire Formation, Cenomanian – Santonian (Jerzykiewicz and Russell 1991; Suzuki and Narmandakh 2004).

Material and references. A partial shell, including plastron with incomplete carapace, and an almost complete skeleton of *Adocus amtgai* (Narmandakh 1985, p. 86, fig. 1; as *Adocoides amtgai*; Sukhanov 2000, p. 335, fig. 17.20; Syromyatnikova et al. 2009, p. 77); shell fragments of *Adocus* sp. (Shuvalov and Chkhikvadze 1979, p. 67); one shell fragment of Adocidae indet. (Suzuki and Narmandakh 2004, p. 8).

Remarks. We retain *Adocoides amtgai* within the genus *Adocus* until further study (Syromyatnikova and Danilov 2009, p. 92). *Adocus amtgai* was mentioned from the upper part of the Bainshire Formation, whereas *Adocus* sp., from the lower part of the same formation. Some authors do not distinguish parts of the Bainshire Formation in this locality, the approach we follow herein (see also Danilov and Syromyatnikova 2008, p. 6).

9. Aravan II, Osh Province, south-western Fergana, Kyrgyzstan.

Geology and age. Yalovach Formation, early Santonian (Nessov 1997).

Material and references. Shell fragments of *Shachemys* sp. (Fig. 3C; Nessov 1997, p. 119).

10. Ayazkala, southern Ayazkala Hill, Uzbekistan.

Geology and age. Upper part of the Khodzhakul Formation, early Cenomanian (Nessov 1997).

Material and references. Shell fragments of *Ferganemys* sp.* (Nessov 1997, p. 140; Syromyatnikova 2011, p. 40).

11. Baga Tarjach, Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Djadokhta Formation, Campanian (Jerzykiewicz and Russell 1991).

Material and references. Shell fragments of *Adocus* sp.* (Shuvalov and Trusova 1979, p. 85).

12. Bain Shire (=Bayn Shire), Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Bainshire Formation, Cenomanian – Santonian (Jerzykiewicz and Russell 1991; Suzuki and Narmandakh 2004).

Material and references. Five shell fragments of Adocidae indet. (Suzuki and Narmandakh 2004, p. 8).

13. Ban Lam Thoy, Tang Vay area, south of Muong Phalan, Savannakhet Province, Laos.

Geology and age. Gres superieurs Formation, Aptian – Albian (Lapparrent de Broin 2004).

Material and references. "A part of a large dorsal shell" and a partial small shell of *Shachemys laosiana* on one slab of matrix (as aff. *Xinjiangchelys* sp.; Lapparrent de Broin 2004, p. 389; pers. observations of IGD and EVS); several partial shells, skulls, posterior cervical vertebrae, remains of the girdles, anterior and posterior limbs of *Shachemys laosiana* (Lapparrent de Broin 2004, p. 394, figs B–R).

14. Ban Saphan Hin, Nakhon Ratchasima Province, north-eastern Thailand.

Geology and age. Khok Kruat Formation, Aptian – Albian (Tong et al. 2005, 2006b, 2009).

Material and references. A fragment of carapace and right hypoplastron of *Shachemys* sp. (Tong et al. 2005, p. 613, fig. 3; 2006b, p. 188, fig. 5; 2009, p. 146, fig. 4).

15. Baybishe (=Baybishe I), north-eastern Aral Sea area, Kazakhstan.

Geology and age. Bostobe Formation, Santonian – early Campanian (Nessov 1997).

Material and references. 14 isolated shell fragments of *Adocus bostobensis* (for review see Syromyatnikova and Danilov 2009, p. 90, fig. 8A, B, G, K, N); partial carapace and fragments of plastron of *Shachemys baibolatica* (Kuznetsov and Shilin 1983, p. 41, figs a, b; Danilov et al. 2007, pl. III, figs 1, 2).

16. Baykhozha, north-eastern Aral Sea area, Kazakhstan.

Geology and age. ?Bostobe Formation, Santonian – early Campanian (Nessov 1997).

Material and references. Shell fragments of Adocidae indet.* (as Dermatemydidae; Rozhdestvensky and Khozatsky 1967; as Adocidae indet.; Nessov 1997, p. 110).

17. Bayshin Tsav, Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Upper part of the Bainshire Formation, late Turonian – Santonian (Shuvalov and Chkhikvadze 1975; Suzuki and Narmandakh 2004).

Material and references. Shell fragments of *Adocus* sp.* (Tsybin and Kurzanov 1979, p. 112); one shell fragment of Adocidae indet. (Suzuki and Narmandakh 2004, p. 8).

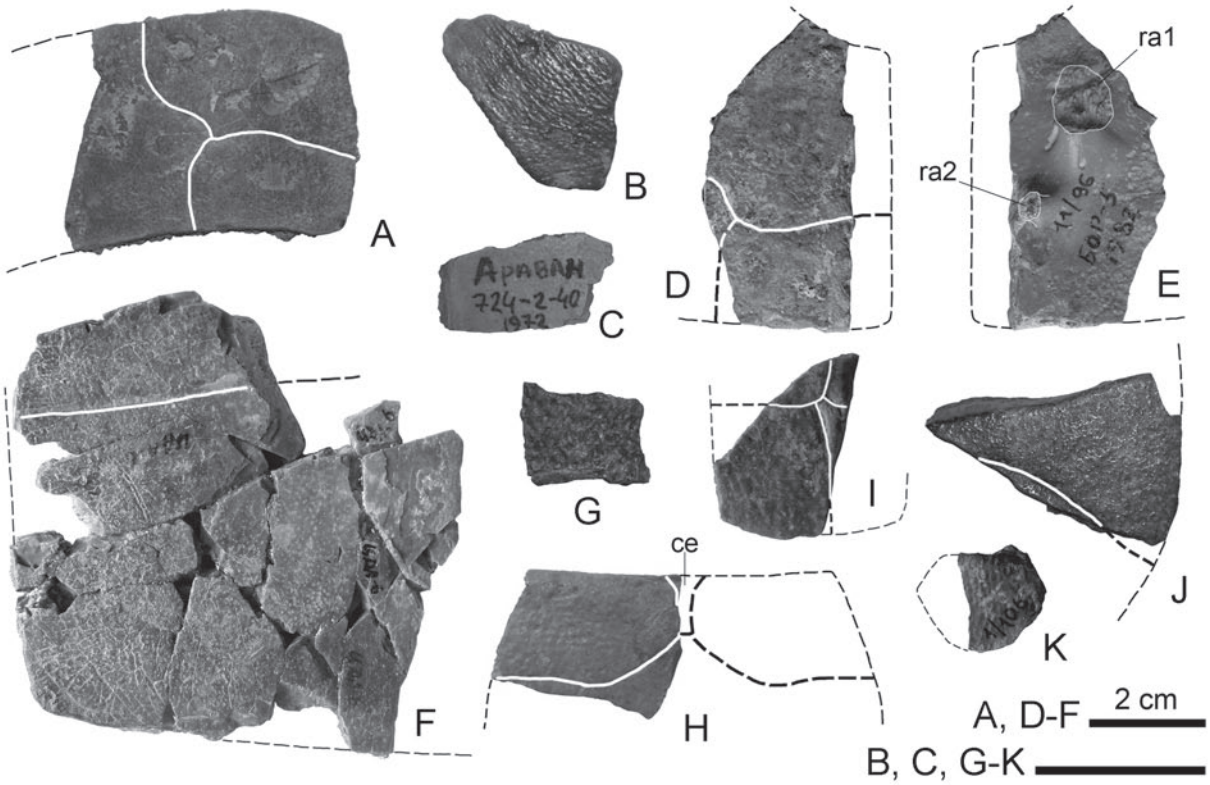

Fig. 3. Adocidae, shell fragments: A – ZIN PH 6/96, *Shachemys baibolatica,* fragment of left costal 5 in dorsal view, Akkurgan, north-eastern Aral Sea area, Kazakhstan; Bostobe Formation, Santonian – early Campanian; B – ZIN PH 1/113, *Shachemys* sp., undetermined shell fragment in external view, Alymtau, Circum-Tashkent Chul, Kazakhstan; Syuksyuk Formation, Santonian; C – ZIN PH 1/142, *Shachemys* sp., undetermined shell fragment in external view, Aravan II, Osh Province, south-western Fergana, Kyrgyzstan; Yalovach Formation, early Santonian; D, E – ZIN PH 11/95, *Shachemys baibolatica*, fragment of left costal 1, Buroynak, north-eastern Aral Sea area, Kazakhstan; Bostobe Formation, Santonian – early Campanian: D – dorsal view; E – ventral view; F – ZIN PH 1/116, *Shachemys* sp., fragment of left hypoplastron in ventral view, Daugyztau I, Central Kyzylkum, Uzbekistan; late Turonian – oniacian; G – CCMGE 4/12088, "*Adocus*" sp. indet., undetermined shell fragment in external view, Dzhylga, Chimkent Province, Circum-Tashkent Chul, Kazakhstan; Late Paleocene; H–J – Adocidae, shell fragments, Karamurun II, Central Kyzylkum, Uzbekistan; ?early Turonian: H – ZIN PH 1/105, Adocidae indet., fragment of nuchal in dorsal view; I – ZIN PH 2/105, Adocidae indet., fragment of bridge peripheral in dorsal view; J – ZIN PH 3/105, *Shachemys* sp., fragment of left xiphiplastron in ventral view; K – ZIN PH 1/106, Adocidae indet., fragment of neural 6 or 7 in dorsal view, Kulkuduk II, Central Kyzylkum, Uzbekistan; ?Turonian. Photographs. Abbreviations: abf – axillary buttress fossa; c – costal; ce – cervical; egu – extragular; gu – gular; ia – ilial attachment; ibf – ingunal buttress fossa; im – inframarginal; pe – pectoral; ra – ribhead attachment; fr – free rib. Arabic numerals designate element numbers. Tentative sutures and sulci are shown with dashed lines.

18. Baytuma, Tastau Mountains, Dzhungar Alatau Ridge, Kazakhstan.

Geology and age. Sasykol Formation, Late Cretaceous (Nessov 1997).

Material and references. Shell fragments of *Adocus* sp.* (Nessov 1997, p. 115).

19. Burkhant, Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Bainshire Formation, Cenomanian – Santonian (Suzuki and Narmandakh 2004).

Material and references. Two shell fragments "including an anterior half of plastron" of *Adocus* sp. (as Adocidae indet.; Suzuki and Narmandakh 2004, p. 8, pl. 1, fig. 4).

Remarks. The attribution of the anterior half of the plastron to *Adocus* sp. is based on proportions of epiplastra and entoplastron as well as sculpturing of the shell with small pits.

20. Buroynak (=Buroynak I & II), north-eastern Aral Sea area, Kazakhstan.

Geology and age. Bostobe Formation, Santonian – early Campanian (Nessov 1997).

Material and references. Nine isolated shell fragments of *Adocus bostobensis* (for review see Syromyatnikova and Danilov 2009, p. 90, fig. 8C, F); three shell fragments of *Shachemys baibolatica* (Fig. 3D, E; as *Shachemys* sp.; Nessov 1997, p. 111).

Remarks. We assign *Shachemys* material from Buroynak to *Sh. baibolatica*, because this is species is known from other localities of the Bostobe Formation (Danilov et al. 2007).

21. Changet IV, north-eastern Fergana, Kyrgyzstan.

Geology and age. Yalovach Formation, Santonian (Nessov 1997).

Material and references. Shell fragments of *Shachemys* sp.* (Nessov 1997, p. 119).

22. Chelpyk (=Tçelpyk), Sultanuvais Range, Uzbekistan.

Geology and age. Khodzhakul Formation, early Cenomanian (Averianov and Archibald 2005).

Material and references. A neural of "*Ferganemys*" *itemirensis* (as Adocidae indet.; Nessov 1997, p. 140, pl. 33, fig. 6); numerous isolated shell fragments of "*F.*" *itemirensis* (Nessov and Krasovskaya 1984, p. 16; as *F. verzilini*; Nessov 1997, p. 140; as "*F.*" *itemirensis*; Syromyatnikova 2011, p. 42, figs 2B, 3A, C–T, 4A–G, 5).

Remarks. The attribution of the neural mentioned as Adocidae indet. to "*F.*" *itemirensis* is based on that the plate is relatively narrow posteriorly and rather thick, morphology known only for this species in the assemblage of the Khodzhakul Formation. *Ferganemys verzilini* is known from the Albian of Kyrgyzstan only (see Kylodzhun I) and mentioned from Chelpyk by mistake (see also Syromyatnikova 2011).

23. Daugyztau I, Central Kyzylkum, Uzbekistan.

Age. Late Turonian – oniacian (Nessov 1997).

Material and references. Two shell fragments of *Shachemys* sp. (Fig. 3F; Nessov 1997, p. 152).

24. Dersnii Khuduk, Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Lower part of the Bainshire Formation, Cenomanian – early Turonian (Shuvalov and Chkhikvadze 1975; Jerzykiewicz and Russell 1991).

Material and references. Shell fragments of ?*Adocus* sp.* (Shuvalov and Chkhikvadze 1975, pp. 216, 217, 225).

Remarks. Besides mentioning shell fragments of ?*Adocus* sp., Shuvalov and Chkhikvadze (1975, p. 225, pl. I, fig. 2) described and figured a posterior peripheral plate of ?Adocidae gen. et sp. indet. from this locality. Later, Shuvalov and Chkhikvadze (1979, p. 74) supposed that this specimen may belong to *Anosteira shuwalovi* Chkhikvadze in Shuvalov et Chkhikvadze, 1979, a poorly known carettochelyid from the Bainshire Formation.

25. Dzharakuduk I (=Dzhirakuduk I), Central Kyzylkum, Uzbekistan.

Age. Lower part of the early Turonian (Nessov 1997).

Material and references. Shell fragments of *Shachemys* sp.* (Nessov 1997, p. 143).

26. Dzharakuduk II (=Dzhirakuduk II), Central Kyzylkum, Uzbekistan.

Geology and age. Bissekty Formation, late Turonian (Nessov 1997).

Material and references. About 200 isolated shell fragments of *Adocus aksary* (for review see Syromyatnikova and Danilov 2009, p. 77, figs 3–6); about 700 isolated shell fragments of *Shachemys ancestralis* (for review see Danilov et al. 2007, p. 67, pls VI–VIII).

27. Dzhurtas (=Dzhurtan; =Dzhurmas), Dzhungar Alatau Ridge, south-eastern Kazakhstan.

Age. Santonian – early Campanian (Nessov 1995a, 1997).

Material and references. Four isolated shell fragments of *Adocus dzhurtasensis* (as *Shachemys* sp.; Nessov 1997, p. 113; as *A. dzhurtasensis*; for review see Syromyatnikova and Danilov 2009, p. 89, fig. 7O–Q).

Remarks. Nessov (1997) reported *Shachemys* sp. from Dzhurtas without any arguments. Our examination of all turtle specimens from Dzhurtas studied by Nessov (collection ZIN PH 92) showed that all of them belong to *Adocus dzhurtasensis*.

28. Dzhylga, Chimkent Province, Circum-Tashkent Chul, Kazakhstan.

Age. Late Paleocene (Chkhikvadze 1990; Averianov 1997).

Material and references. One undetermined shell fragment of "*Adocus*" sp. indet. (Fig. 3G; as Adocidae; Nessov and Chkhikvadze 1987, p. 177; Chkhikvadze 1990, p. 8).

29. Dzun Shakhai, Dornogov Aimag (Eastern Gobi), Mongolia.

Age. Early Cretaceous (Suzuki and Narmandakh 2004).

Material and references. One shell fragment of Adocidae indet.* (Suzuki and Narmandakh 2004, p. 8).

30. Ergil Obo (=Ardyn Obo; =Ergelyeen Dzo; =Ergiliin Dzo; =Khoer Dzan), Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Ergiliin Dzo (=Ardyn Obo) Formation, Late Eocene (Meng and McKenna 1998).

Material and references. Shell fragments of "*Adocus*" *orientalis* (Sukhanov 2000, p. 333), see Systematics section.

Remarks. Primarily, this record was mentioned as ?*Adocus orientalis* from the Khoer Dzan locality, Ergiliin Dzo Formation (Narmandakh 1991). Later, Sukhanov (2000) wrote that it was coming from the Ergil Obo.

31. Gaofengshan (=Kao-feng-shan), Dazu (=Tatsu, =Longang) County, Chongqing Province, China.

Geology and age. Probably, Shaximiao Formation, Late Jurassic (Danilov and Parham 2006).

Material and references. An incomplete shell with partially exposed girdles, hindlimbs and tail of *Yehguia tatsuensis* (for review see Danilov and Parham 2006, p. 578, figs 2, 3).

Remarks. Recent phylogenetic studies (Danilov and Syromyatnikova 2009a, p. 72; 2009b, p. 45) place *Yehguia tatsuensis* as the most basal member of the Adocidae.

32. Itemir, Bukhara Province, Central Kyzylkum, Uzbekistan.

Geology and age. Orazalin, Kulbecke, Itemir, Bortesken and Dzharakuduk members, Cenomanian (Nessov 1997).

Material and references. Two peripherals 2 of *Adocus* sp. indet. (Syromyatnikova and Danilov 2009, p. 92, fig. 8O–P); several isolated shell fragments of "*Ferganemys itemirensis*" (Nessov 1981, p. 70, pl. III, figs 6, 7; Nessov and Krasovskaya 1984, p. 23, pl. 3, fig. 28, pl. 4, fig. 14; Nessov 1997, pp. 136, 137, pl. 34, figs 5, 18, pl. 35, figs 1, 2; as "*F.*" *itemirensis*; Syromyatnikova 2011, p. 42, figs 2B, 3B, 4H–J); shell fragments and imprints of shell fragments of Adocidae indet. (as cf. *Ferganemys* or cf. *Adocus*; Nessov 1997, p. 136; as Adocidae indet.; Nessov 1997, p. 137, pl. 35, fig. 6).

Remarks. Shell fragments of Adocidae indet. have been reported from each member of Itemir (Nessov 1997, pp. 136, 137), but in most cases specimen-member correspondence is unclear. Nessov (1997, pl. 35, figs 5, 6) assigned two imprints of shell fragments from Itemir to Adocidae indet., but only one of them belongs to Adocidae based on adocid sculpturing (Nessov 1997, pl. 35, fig. 6), whereas another one should be tentatively referred to Testudines indet.

33. Kan, southern Fergana, Kyrgyzstan.

Geology and age. Sharikhan Formation, Cenomanian (Nessov 1997).

Material and references. Shell fragments of "*Adocus* sp. or large-sized *Ferganemys* sp."* (Nessov 1997, p. 118).

34. Kansai, Fergana Depression, Tajikistan.

Geology and age. Yalovach Formation, early Santonian (Nessov 1997).

Material and references. Thirteen isolated shell fragments of *Adocus foveatus* (for review see Syromyatnikova and Danilov 2009, p. 85, fig. 7A–E); about 500 isolated shell fragments of *Shachemys baibolatica* (for review see Danilov et al. 2007, pl. IV, figs 1, 2, 4–9, 11–14, 16, pl. V).

35. Karachadalysay, Sultanuvais Range, Uzbekistan.

Geology and age. ?Upper part of the Khodzhakul Formation, early Cenomanian (Nessov 1997).

Material and references. Shell fragments of Adocidae indet.* (as Dermatemydidae; Shul'ts 1972, fig. 31; as Adocidae; Nessov 1997, p. 141).

36. Karakul, Sultanuvais Range, Uzbekistan.

Geology and age. Sultanbobo Formation, late Aptian (Nessov 1997).

Material and references. Shell fragments of cf. *Adocus* sp.* (Nessov 1997, p. 133; Syromyatnikova and Danilov 2009, p. 93).

37. Karamurun II, Central Kyzylkum, Uzbekistan.

Age. ?Early Turonian (Nessov 1997).

Material and references. Fragments of the nuchal and bridge peripheral of Adocidae indet. (Fig. 3H, I; as *Shachemys* sp.; Nessov 1997, p. 142); fragment of the xiphiplastron of *Shachemys* sp. (Fig. 3J; Nessov 1997, p. 142).

Remarks. The above mentioned fragments of the nuchal and bridge peripheral does not allow determination more precise than Adocidae indet.

38. Karatepa, Sultanuvais Range, Uzbekistan.

Geology and age. Upper part of the Khodzhakul Formation, early Cenomanian (Nessov 1997).

Material and references. Shell fragments of cf. *Ferganemys* sp.* (Nessov 1997, p. 141; Syromyatnikova 2011, p. 40).

39. Katsuyama, Fukui Prefecture, Japan.

Geology and age. Kitadani Formation, Barremian or Aptian (Hirayama 2002).

Material and references. About 70 isolated shell fragments of *Adocus* sp. (Hirayama 2002, p. 30, figs 1–3, 4A–B).

40. Kazgurt (=Fogelevka; =Fogelevo), Circum-Tashkent Chul, Kazakhstan.

Geology and age. Syuksyuk Formation, Santonian (Nessov 1997).

Material and references. Shell fragments of *Shachemys* sp.* (Nessov 1997, p. 108).

41. Khara Khutul (=Khara Khutul Ula; =Khar Hötöl Uul), Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Lower part of the Bainshire Formation, Cenomanian – early Turonian (Shuvalov and Chkhikvadze 1975).

Material. Isolated shell fragments of *Adocus* sp. indet. 1, see Systematics section.

42. Khodzhakul I, Sultanuvais Range, Uzbekistan.

Geology and age. Lower part of the Khodzhakul Formation, early Cenomanian (Averianov and Archibald 2005).

Material and references. Six isolated shell fragments of *Adocus kizylkumensis* (for review see Syromyatnikova and Danilov 2009, p. 87, fig. 7F–J); shell fragments of Adocidae indet. (as *Ferganemys* (?) sp.; Nessov 1997, p. 135).

Remarks. The shell fragments previously reported as *Ferganemys* (?) sp. does not allow determination more precise than Adocidae indet. (see also Syromyatnikova 2011, p. 39).

43. Khodzhakul II, Sultanuvais Range, Uzbekistan.

Age. Late Paleocene (see Remarks).

Material and references. Shell fragments of Adocidae indet.* and *Ferganemys* sp. cf. *F. itemirensis** (Nessov 1997, p. 155; Syromyatnikova 2011, p. 40).

Remarks. According to Nessov (1997, p. 155), this material, probably, was redeposited from the Cenomanian.

44. Khodzhakul III, Sultanuvais Range, Uzbekistan.

Geology and age. Lower part of the Khodzhakul Formation, early Cenomanian (Nessov 1997).

Material and references. Shell fragments of Adocidae indet.* (Nessov 1997, p. 134).

45. Khodzhakulsay, Sultanuvais Range, Uzbekistan.

Geology and age. Upper part of the Khodzhakul Formation, early Cenomanian (Averianov and Archibald 2005).

Material and references. Isolated shell fragments of *Adocus kizylkumensis* (for review see Syromyatnikova and Danilov 2009, p. 87); isolated shell fragments of "*Ferganemys itemirensis*" (Nessov 1981, p. 70; 1997, p. 139, pl. 34, figs 6–10, 13, 14; as *Ferganemys*; Nessov 1981, p. 71, pl. III, figs 8–10; as *Ferganemys* sp.; Nessov 1997, pl. 34, figs 7–9; as "*F.*" *itemirensis*; Syromyatnikova 2011, p. 42, figs 2B, 3A, C–T, 4A–G, 5).

46. Khongil, Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Bainshire Formation, Cenomanian – Santonian (Khosatzky 1999)

Material. One undetermined shell fragment of *Adocus* sp. indet. 2, see Systematics section.

47. Kokcha I (=Jaman Kokcha I; =Yaman Kokcha), Kyzylkum, Uzbekistan.

Geology and age. Beshtyube Formation(?), early(?) Turonian (Nessov 1984, 1997).

Material. Shell fragments of Adocidae indet., see Systematics section.

48. Koskuduk, Central Kyzylkum, Uzbekistan.

Age. Early Turonian – Coniacian (Nessov 1997).

Material and references. Shell fragments of *Shachemys* sp.* (Nessov 1997, p. 153).

49. Kuji City, Iwate Prefecture, northeastern Japan.

Geology and age. Kuji Group, upper part of the Tamagawa Formation, Santonian (Hirayama et al. 2010).

Material and references. A nearly complete shell of *Adocus* sp. (Hirayama et al. 2010, p. 78, figs 4–7).

50. Kulkala, Sultanuvais Range, Uzbekistan.

Age. Cenomanian – early Turonian (Nessov 1997).

Material and references. Shell fragments of Adocidae indet.* (Nessov 1997, p. 142).

51. Kulkuduk II, Central Kyzylkum, Uzbekistan.

Age. ?Turonian, probably, early Turonian (Nessov 1997).

Material and references. Fragment of neural 6 or 7 of Adocidae indet. (Fig. 3K; Nessov 1997, p. 144).

52. Kylodzhun I (=Klaudzin), south-eastern Fergana, Kyrgyzstan.

Geology and age. Upper part of the Alamyshyk Formation, late Albian (Nessov and Khosatzky 1977; Nessov 1984).

Material and references. About 3000 shell fragments and several skull fragments of *Ferganemys verzilini* (Nessov and Khosatzky 1977, p. 249, figs 1–3, pl.: figs 1–24; Nessov 1977, p. 78, figs 1, 2, XII, XIII (figs 1, 2); 1986, fig. 7; 1987, fig. 5, pl. I: fig. 15, pl. II: fig. 7; 1997, p. 117, pl. 35: figs 8, 9, pls 36–38; Syromyatnikova 2011, p. 40, fig. 2A).

53. Kyrkkuduk I, Circum-Tashkent Chul, Kazakhstan.

Geology and age. Syuksyuk Formation, Santonian (Nessov 1997).

Material and references. Shell fragments of *Shachemys* sp. (Fig. 4A–H; as Dermatemydidae? gen. et sp. indet.; Riabinin 1938; as *Shachemys baibolatica*; Nessov 1997, p. 107).

Remarks. This material does not allow determination more precise than *Shachemys* sp. In addition, Nessov (1997, p. 108) mentioned records of *Shachemys* sp.* in 1 km East from the Kyrkkuduk well (Syuksyuk Formation?, Santonian?).

54. Kyzylpilyal' I (=Isfara II), right-bank of Isfara River, south-western Fergana, Tajikistan.

Geology and age. Yalovach Formation, early Santonian (Nessov 1997).

Material and references. Shell fragments of *Adocus* sp. cf. *Adocus foveatus** (Nessov 1997, p. 131); a fragment of the left epiplastron of *Shachemys baibolatica* (Nessov 1997, p. 131, pl. 39, fig. 5).

Remarks. The collection ZIN PH 83 includes some materials of *Sh. baibolatica* from Isfara River area without exact locality data. Part of this material, probably, comes from Kyzylpilyal' I.

55. Kyzylpilyal' II, right-bank of Isfara River, south-western Fergana, Tajikistan.

Geology and age. Lower part of the Palvantash Formation, late Santonian – ?early Campanian (Nessov 1997).

Material and references. Shell fragments of *Adocus foveatus** and *Shachemys baibolatica** (Nessov 1997, p. 132).

56. Lyagan, southern Fergana, Uzbekistan.

Geology and age. Middle part of the Sharikhan Formation, Cenomanian (Verzilin 1976), and middle part of the Yalovach Formation, Santonian (Nessov 1997).

Material and references. Shell fragments of Adocidae indet. from the Sharikhan Formation (Fig. 4I, J); *Shachemys* sp.* from the Yalovach Formation (Nessov 1997, p. 155).

Remarks. The shell fragments of Adocidae indet. were collected in Lyagan by N.N. Verzilin in 1971.

57. North Mesa, Chimney Butte Quarry, Shara Murun region, Inner Mongolia, China.

Geology and age. Ulan Shireh Formation, Late Eocene (Gilmore 1931).

Material and references. Fragments of plastron of cf. "*Adocus*" *orientalis*, see Systematics section.

58. Ongon Ulan Ula, Gov–Altai Aimag (Transaltai Gobi), Mongolia.

Geology and age. Upper part of the Bainshire Formation, late Turonian – Santonian (Shuvalov and Ckhikvadze 1986).

Material and references. An epiplastron and fragments of costals of Shachemydinae indet. (as *Mlynarskiella mariani*; Shuvalov and Ckhikvadze 1986, p. 433, fig. 1; Chkhikvadze and Shuvalov 1988, p. 510, pl. XIX).

Remarks. *Mlynarskiella mariani* was established based on the single epiplastron and costal fragments (Shuvalov and Chkikvadze 1986). General proportions of the epiplastron, position of sulci and, probably, also sculpturing are similar to those of Shachemydinae, especially *Ferganemys* spp. Fusion of gulars, suggested as a diagnostic character of this taxon by Shuvalov and Chkhikvadze (1986, 1988), can not be established for sure, because midline sulcus in adocids could be asymmetric. For this reason, this material is determined as Shachemydinae indet, and *Mlynarskiella mariani* is considered to be a nomen dubium.

59. Phu Kum Khao, Kalasin Province, Thailand.

Geology and age. Sao Khua Formation, Early Cretaceous, ante-Aptian (Tong et al. 2006a, 2006b, 2009).

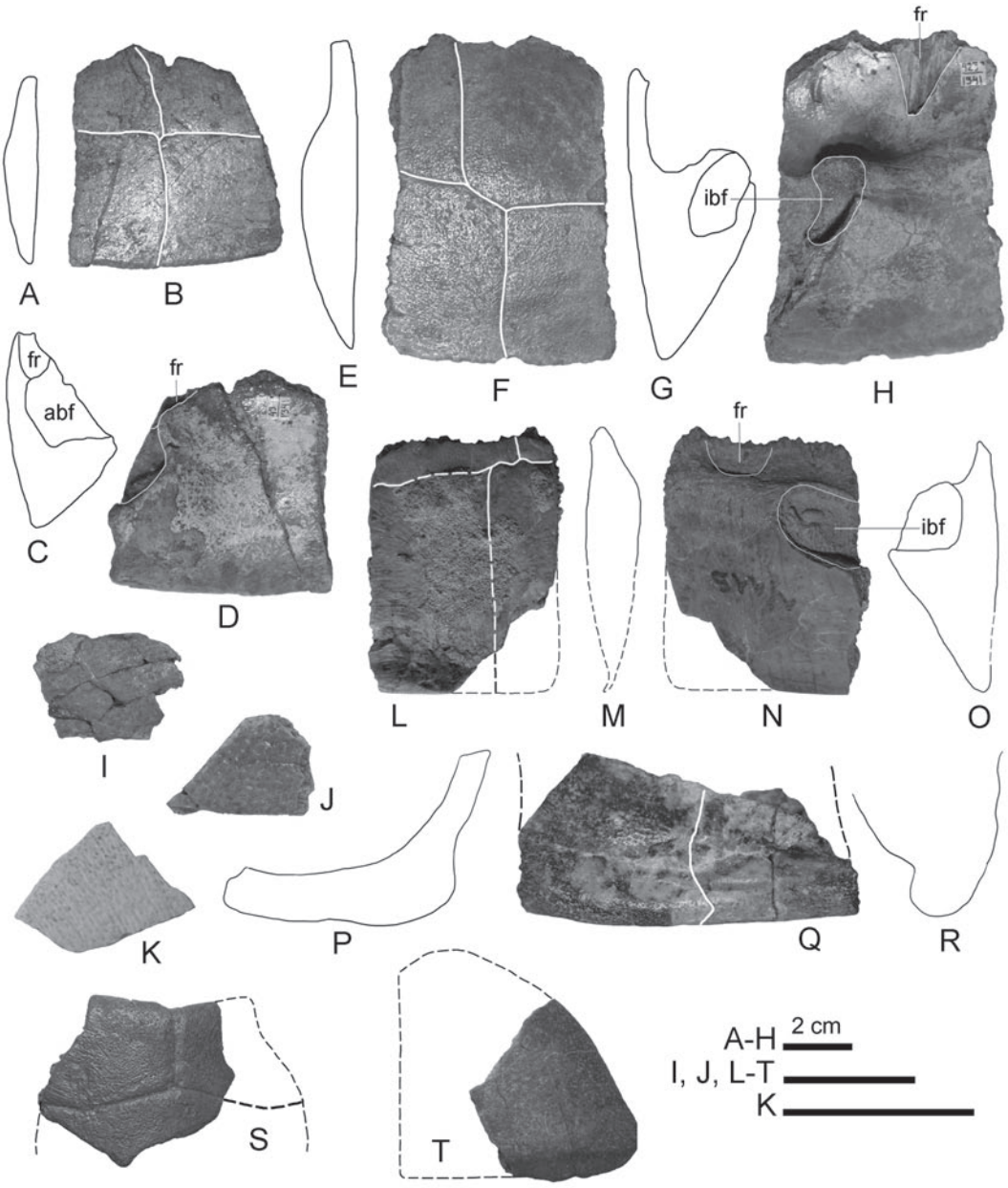

Fig. 4. Adocidae, shell fragments: A–H – *Shachemys* sp., shell fragments, Kyrkkuduk I, Circum-Tashkent Chul, Kazakhstan, Syuksyuk Formation, Santonian: A–D – CCMGE 434/1341, left peripheral 2: A – cross section at anterior border; B – dorsal view; C – cross section at posterior border; D – ventral view; E–H – CCMGE 423/1341, right peripheral 8: E – cross section at posterior border; F – dorsal view; G – cross section at anterior border; H – ventral view; I, J – ZIN PH 1, 2/141, Adocidae indet., undetermined shell fragments in external view, Lyagan, southern Fergana, Uzbekistan; middle part of Sharikhan Formation, Cenomanian: I – ZIN PH 1/141, J – ZIN PH 2/141; K – ZIN PH 1/98, *Shachemys* sp., undetermined shell fragment in external view, Syuk-Syuk, Circum-Tashkent Chul, Kazakhstan; Syuksyuk Formation, Santonian; L–O – ZIN PH 1/115, *Shachemys* sp., fragment of left peripheral 8, Tamdy-Truba, Central Kyzylkum, Uzbekistan; Aitym Formation, Santonian: L – dorsal view; M – cross section at posterior border; N – ventral view; O – cross section at anterior border; P–R – ZIN PH 2/75, "*Adocus*" *kazachstanica* (?), fragment of right peripheral 3, Kalmakpai, Zaisan Basin, eastern Kazakhstan; Nothernzaisan Group the Paleocene: P – cross section at posterior border; Q – dorsal view; R – cross section at anterior border; S, T – *Shachemys baibolatica*, shell fragments, Zumuratsho, left-bank of Isfara River, south-eastern Fergana, Tajikistan, Yalovach Formation, early Santonian: S – ZIN PH 1/83, fragment of nuchal in dorsal view; T – ZIN PH 4/83, fragment of left epiplastron in ventral view. B, D, F, H–L, N, Q, S, T – photograps; A, C, E, G, M, O, P, R – drawings. See Figure 3 for abbreviations and designations.

Material and references. Several partial shells of *Isanemys srisuki* (Tong et al. 2006a, p. 129, figs 2, 5; 2009 p. 143, fig. 1).

60. Phu Wat, Khon Kaen Province, Thailand.

Geology and age. Sao Khua Formation, Early Cretaceous, ante-Aptian (Tong et al. 2006a, 2006b, 2009).

Material and references. Several partial shells of *Isanemys srisuki* (Tong et al. 2006a, p. 129; 2006b, p. 186; 2009, p. 143).

61. Pitnyak, Daşoguz Province, Turkmenistan.

Age. ?Coniacian (Nessov 1997).

Material and references. Shell fragments of Adocidae indet.* (Nessov 1997, p. 133).

62. Shakh-Shakh, north-eastern Aral Sea area, Kazakhstan.

Geology and age. Bostobe Formation, Santonian – early Campanian (Nessov 1997).

Material and references. Six isolated shell fragments of *Adocus bostobensis* (for review see Syromyatnikova and Danilov 2009, p. 90, fig. 8D, E, J); about hundred isolated shell fragments of *Shachemys baibolatica* (for review see Danilov et al. 2007, p. 62, pl. IV, figs 3, 10, 15).

63. Shatyrtyube I, Central Kyzylkum, Uzbekistan.

Age. Santonian (Nessov 1997).

Material and references. Shell fragments of *Adocus* sp.* and *Shachemys* sp.* (Nessov 1997, p. 154).

64. Shatyrtyube II, Central Kyzylkum, Uzbekistan.

Age. Santonian (Nessov 1997).

Material. Isolated shell fragments of *Shachemys* sp. indet. 2, see Systematics section.

65. Sheikhdzheili II, Sultanuvais Range, Uzbekistan.

Geology and age. Upper part of the Khodzhakul Formation, early Cenomanian (Averianov and Archibald 2005).

Material and references. Fifteen isolated shell fragments of *Adocus kizylkumensis* (for review see Syromyatnikova and Danilov 2009, p. 87); numerous isolated shell fragments of "*Ferganemys itemirensis*" (Nessov and Krasovskaya 1984, pl. 3, figs 21–27; Nessov 1986, fig. 8; 1997, p. 138, pl. 34, figs 11, 12, 15; as "*F.*" *itemirensis*; Syromyatnikova 2011, p. 42, figs 2B, 3A, C–T, 4A–G, 5).

66. Sheikhdzheili III, Sultanuvais Range, Uzbekistan.

Geology and age. Lower or middle part of the Khodzhakul Formation, early Cenomanian (Nessov 1997).

Material and references. Shell fragments of Adocidae indet.* (Nessov 1997, p. 134).

67. Sheykh-Aryk, Daşoguz Province, Turkmenistan.

Age. ?Early Santonian (Nessov 1997).

Material and references. Shell fragments of Adocidae indet.* (Nessov 1997, p. 133).

68. Shine Us Khuduk (=Shine Us Khudag), Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Lower part of the Bainshire Formation, Cenomanian – early Turonian (Sukhanov 2000; Sukhanov and Narmandakh 2006).

Material and references. Plastron and "numerous isolated plates" of *Adocus planus* (as *Shineusemys plana*; Sukhanov 2000, p. 336, fig. 17.21; Sukhanov and Narmandakh 2006, p. 124).

Remarks. *Shineusemys plana* was diagnosed by relatively short bridges and by abdominals shorter than femorals (Sukhanov 2000; Sukhanov and Narmandakh 2006). However, variation of these characters is poorly studied in adocids, and, in any case, they alone are not enough to diagnose the genus in this group. In all other characters this taxon well corresponds to *Adocus* sensu lato and here considered to be a species of this genus.

69. Shine Usny Tolgod, Dornogov Aimag (Eastern Gobi), Mongolia.

Age. Early Cretaceous (Suzuki and Narmandakh 2004).

Material and references. Two shell fragments of Adocidae indet.* (Suzuki and Narmandakh 2004, p. 8).

70. Shiramine-mura, Ishikawa Prefecture, Central Japan.

Geology and age. Kuwajima Formation, Valanginian – Hauterivian (Hirayama et al. 2000; Sonoda and Hirayama 2009).

Material and references. "Hundred specimens, including few articulated shells, skulls, lower jaws, cervicals and appendicular skeletons" of a new genus and species of Adocidae (as "a new genus and species of Trionychoidea"; Hirayama 2000, pls 28, 29 (figs 1–5), 30–33; as Trionychoidea indet.; Hirayama et al.

2000, p. 186, figs 7, 9; as Trionychoidea type A; Sonoda and Hirayama 2009; as Gen. et sp. indet. A; Hirayama 2010, p. 20, fig. 1; as trionychoids A and B; Hirayama 2010, p. 21, fig. 2).

Remarks. Hirayama et al. (2000) noted similarity of these materials with Adocidae and Nanhsiungchelyidae. Here this record is considered as Adocidae based on pygal longer than wide, adocid sculpturing and shallow and narrow shell scale sulci (see Danilov and Syromyatnikova 2009b for adocid synapomorphies).

71. Shokawa, Gifu Prefecture, Central Japan.

Geology and age. Okurodani Formation, Neocomian (Hirayama et al. 2000).

Material and references. "Hundred specimens, including few articulated shells, skulls, lower jaws, cervicals and appendicular skeletons" of a new genus and species of Adocidae (as Trionychoidae indet.; Hirayama et al. 2000, p. 186, fig. 8; as undescribed trionychoid; Hirayama 2010, p. 21, fig. 2).

Remarks. See Remarks section under Shiramine-mura above.

72. Shorsu, interfluves of Isfara and Shorsu Rivers, Tajikistan.

Geology and age. Yalovach Formation, early Santonian (Nessov 1997).

Material. Shell fragments of *Shachemys* sp. indet. 3, see Systematics section.

73. Shurab, southern Fergana, Tajikistan.

Age. ?Late Turonian (Nessov 1997).

Material and references. Shell fragments of *Shachemys* sp.* (Nessov 1997, p. 132).

74. Suining, Sichuan Province, China.

Age. Late Jurassic (see Remarks).

Material and references. A nearly complete carapace of *Yehguia tatsuensis* in the collection of CNHM (as *Sinaspideretes wimani* Young et Chow, 1953; Hirayama 2001, fig. 35).

Remarks. According to Hirayama (2001), this specimen comes from the Middle Jurassic of Jigong, Sichuan Province; *Sinaspideretes wimani* is considered as a senior synonym of *Plesiochelys tatsuensis*. According to H. Tong (pers. comm. to IGD, 2010), this specimen is referable to *Yehguia tatsuensis* and comes from the Late Jurassic of Suining, Sichuan Province.

75. Syuk-Syuk (=Sek-Sek), Circum-Tashkent Chul, Kazakhstan.

Geology and age. Syuksyuk Formation, Santonian (Nessov 1997).

Material and references. Shell fragments of *Adocus*? sp.* (Nessov 1997, p. 108); one undetermined shell fragment of *Shachemys* sp. (Fig. 4K; Nessov 1997, p. 108).

76. Tamdy-Truba, Central Kyzylkum, Uzbekistan.

Geology and age. Aitym Formation, Santonian (Nessov 1997).

Material and references. Three isolated shell fragments of *Shachemys* sp. (Fig. 4L–O; as *Sh. baibolatica*; Nessov 1997, p. 153).

Remarks. This material does not allow determination more precise than *Shachemys* sp.

77. Telegraph Line Camp, Irdin Manha, Inner Mongolia, China.

Geology and age. Irdin Manha Formation, Late Eocene (Gilmore 1931).

Material and references. An anterior half of the plastron of *"Adocus" orientalis* (as *Adocus orientalis*; Gilmore 1931, p. 220, fig. 2).

78. Tsagan Teg, Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Upper part of the Bainshire Formation, upper part of the grey section, late Turonian – early Santonian (Tumanova 1983).

Material. Partial peripheral 2 of *Adocus* sp. indet. 3, see Systematics section.

79. Tyul'keli, north-eastern Aral Sea area, Kazakhstan.

Geology and age. Middle part of the Zhirkindek Formation, late Turonian – Coniacian (Nessov 1997; Averianov 2007).

Material and references. Shell fragments of *Shachemys* sp.* (Nessov 1997, p. 106).

80. Uchkuduk, Central Kyzylkum, Uzbekistan.

Geology and age. Bissekty Formation, late Turonian (Nessov 1995b).

Material. About 20 isolated shell fragments of *Shachemys ancestralis*, see Systematics section.

81. Urtyn Obo, East Mesa, Shara Murun region, Inner Mongolia, China.

Geology and age. Ulan Gochu Formation, Early Oligocene (Gilmore 1931).

Material. Two undetermined shell fragments of "*Adocus*" sp. indet. 2, see Systematics section.

82. Ushyin Khuduk, Dornogov Aimag (Eastern Gobi), Mongolia.

Geology and age. Upper part of the Bainshire Formation, late Turonian – Santonian (Shuvalov and Chkhikvadze 1979).

Material and references. Several shell fragments of *Adocus* sp.* (Shuvalov and Chkhikvadze 1979, pp. 70, 71).

83. Zaisan Basin: Aksyir, Chaybulak, Kalmakpai, Obayla, Ul'ken-Ulasty localities, eastern Kazakhstan.

Geology and age. Obayla Formation, Middle Eocene (Chkhikvadze 1973).

Material and references. Isolated shell fragments of "*Adocus*" *kazachstanica* (Chkhikvadze 1973, p. 33, fig. 5, pl. 6, figs 1, 2, pl. 7, figs 1–3; as *A. orientalis*; Chkhikvadze 1976 and later publications).

Remarks. "*Adocus*" *kazachstanica* has been described from the Obayla Formation, Middle Eocene (Chkhikvadze 1973). In ZIN PH collection, there is a fragment of peripheral 3, probably, belonging to "*Adocus*" *kazachstanica* (Fig. 4P–R) from the Nothernzaisan Group of Kalmakpai. Chkhikvadze (1990) noted Paleocene age for the Nothernzaisan Group, but later (Chkhikvadze 2008) considered the Obayla Formation to be equal with the Northernzaisan Group, Paleocene in age.

84. Zenge Kurgan III, Khorezm Province, Uzbekistan.

Geology and age. ?Bissekty Formation, Turonian (Averianov 2007).

Material. Seven isolated shell fragments of *Shachemys* sp. indet. 4, see Systematics section.

85. Zhaldyrbas Takyr, Central Kyzylkum, Uzbekistan.

Geology and age. Upper part of the Kynyr Formation, Coniacian – Santonian (Nessov 1997).

Material and references. Shell fragments of *Shachemys* sp.* (Nessov 1997, p. 154).

86. Zumuratsho (=Isfara I), left-bank of Isfara River, south-eastern Fergana, Tajikistan.

Geology and age. Yalovach Formation, early Santonian (Nessov 1997).

Material and references. Shell fragments of *Adocus* sp. cf. *Adocus foveatus** and *Shachemys baibolatica* (Fig. 4S, T; as *Shachemys* sp. cf. *Sh. baibolatica*; Nessov 1997, p. 132).

Remarks. Here we refer all specimens collected by N.N. Verzilin from the left bank of Isfara River (collection ZIN PH 83). The attribution of the shell fragments from Zumuratsho to *Shachemys baibolatica* is based on the diagnostic characters of this species: relatively narrow nuchal and long epiplastron (see Danilov et al. 2007).

87. Unknown locality 1, probably, north-eastern regions of Mongolia.

Age. ?Late Cretaceous (Danilov and Syromyatnikova 2008, p. 10).

Material. A fragment of the hypoplastron of *Adocus* sp. indet. 4, see Systematics section.

88. Unknown locality 2 (AIG-1 local site), probably, Central Kyzylkum, Uzbekistan.

Material. A fragment of the right epiplastron of *Shachemys* sp. indet. 5, see Systematics section.

SYSTEMATICS

Family Adocidae Cope, 1870

Genus *Adocus* Cope, 1868

***Adocus* sp. indet. 1**

(Fig. 5A–F)

Material. ZIN PH 3/80, peripheral 2; ZIN PH 4/80, a fragment of the epiplastron; ZIN PH 5/80, a hyoplastron. The specimens were collected in Khara Khutul, Mongolia, by V.F. Shuvalov in 1967.

Description. ZIN PH 3/80 (Fig. 5A–D), left peripheral 2, is from individual with an estimated shell length of about 60 cm. Its free edge is slightly upturned and angled in the cross-section. The plate is thickened along its posterior border, where internally it forms a posteriorly directed bulge, which is occupied by part of the fossa for the axillary buttress. Marginals 2 and 3 are relatively low, occupying about half of the peripheral.

ZIN PH 4/80 (Fig. 5E), an anterior part of the left epiplastron, is from individual with an estimated shell length of about 40 cm. Its anterior edge is rounded. The gular is relatively narrow (its anterior width is less than the length of the epiplastral symphysis). The extragular is with short medial borders that make up about 0.6 of the epiplastral symphysis length.

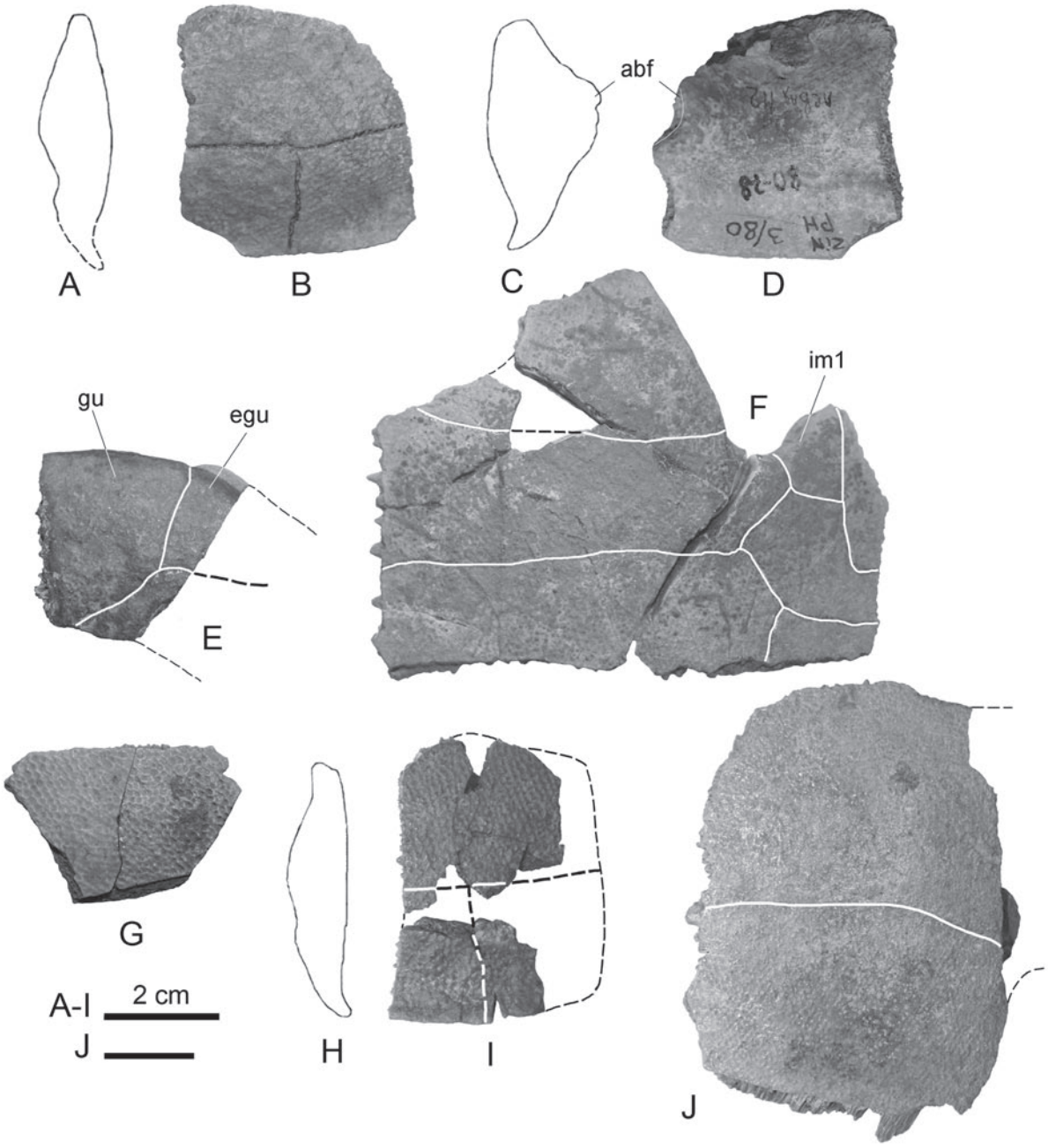

Fig. 5. *Adocus*, shell fragments: A–F – *Adocus* sp. indet. 1, shell fragments, Khara Khutul, Dornogov Aimag, Mongolia; lower part of the Bainshire Formation, Cenomanian – early Turonian: A–D – ZIN PH 3/80, left peripheral 2: A – cross section at anterior border; B – dorsal view; C – cross section at posterior border; D – ventral view; E – ZIN PH 4/80, fragment of left epiplastron in ventral view; F – ZIN PH 5/80, left hyoplastron in ventral view; G – ZIN PH 1/88, *Adocus* sp. indet. 2, undetermined shell fragment in external view, Khongil, Dornogov Aimag, Mongolia; Bainshire Formation, Cenomanian-Santonian; H, I – ZIN PH 1/91, *Adocus* sp. indet. 3, partial peripheral 2, Tsagan Teg, Dornogov Aimag, Mongolia; upper part of the Bainshire Formation, late Turonian – early Santonian: H – cross section at border; I – dorsal view; J – ZIN PH 1/97, *Adocus* sp. indet. 4, fragment of left hypoplastron in ventral view, unknown locality 1, probably, north-eastern regions of Mongolia; ?Late Cretaceous. B, D–G, I, J – photograps; A, C, H – drawings. See Figure 3 for abbreviations and designations.

ZIN PH 5/80 (Fig. 7F), an almost complete left hyoplastron, is from individual with an estimated shell length of about 40 cm. The humeral-pectoral sulcus intersects the entoplastron. The pectorals are slightly longer medially than laterally, without a waist at the lateral third as in some *Adocus* spp. The inframarginals are represented only by inframarginals 1, 2 and part of 3. Inframarginal 1 and anterior part of inframarginal 2 are distant from the plastron-carapace suture, whereas posterior part of inframarginal 2 and anterior part of inframarginal 3 are widened and extended on to peripherals.

Remarks. Attribution of the described specimens to *Adocus* is based on a combination of such characters as sculpturing of the shell surface with small pits, shape of the epiplastron and upturned free edge of peripheral 2. This material is most similar to *Adocus amtgai* from Amtgai locality of Mongolia in morphology of the epiplastron but differs from it by pectorals less shortened laterally.

***Adocus* sp. indet. 2**
(Fig. 5G)

Material. ZIN PH 1/88, one undetermined shell fragment collected in Khongil, Mongolia, by V.F. Shuvalov in 1971.

Remarks. This fragment is assigned to the *Adocus* based on a sculpturing of the shell with small pits.

***Adocus* sp. indet. 3**
(Fig. 5H, I)

Material. ZIN PH 1/91, a partial peripheral 2, collected in Tsagan Teg, Mongolia, by N.N. Verzilin in 1978.

Description and remarks. The partial peripheral 2 is from an individual with an estimated shell length of about 70 cm. Its free edge is upturned with a rounded cross-section. Marginals 2 and 3 are relatively low, occupying about half of the peripheral. The sculpturing of the plate is with small pits. Together these characters allow reliable attribution of this specimen to *Adocus*.

***Adocus* sp. indet. 4**
(Fig. 5J)

Material. ZIN PH 1/97 (field No. 210), a fragment of the left hypoplastron. The material was collected by V.N. Chaykovskiy from unknown locality, probably, in north-eastern regions of Mongolia, where he worked as a geologist, in 1936 (Khosatzky 1976).

Description and remarks. The fragment of the left hypoplastron lacking bridge part is from an individual with an estimated shell length of about 55 cm. The abdominal-femoral sulcus is located in the middle part of the plate. This fragment is assigned to *Adocus* based on a sculpturing of its surface with small pits.

Genus *Shachemys* Kuznetsov, 1976

***Shachemys ancestralis* Nessov in Nessov et Krasovskaya, 1984**
(Fig. 6A, B)

Material. ZIN PH 1/79, a carapace fragment, containing complete left and right costals 7+8; numerous undetermined shell fragments in the same collection (ZIN PH 79). These specimens were collected in Uchkuduk, Uzbekistan, by URBAC expedition, in 2004.

Description and remarks. The costals 7+8 completely contact along the midline; the sculpturing of the shell surface is with small dots (characters of *Shachemys*). Attribution of this specimen to *Sh. ancestralis* is based on its occurrence in the same (Bissekty) formation.

***Shachemys* sp. indet. 1**
(Fig. 6C)

Material. ZIN PH 1/120, distal fragment of even costal, collected in Altyntau, Uzbekistan, by L.A. Nessov.

Description and remarks. The fragment of the costal, probably, belongs to a juvenile individual. It has a weak rib thickening and a narrow and shallow sulcus (characters of adocids). The surface of the plate has a sculpturing with small dots, known in the Cretaceous only in *Shachemys* spp.

***Shachemys* sp. indet. 2**
(Fig. 6D, E)

Material. ZIN PH 1/110, a fragment of the left hypoplastron; ZIN PH 2/110, a fragment of the bridge peripheral; ZIN PH 3–8/110, undetermined shell fragments. All specimens were collected in Shatyrtyube II, Uzbekistan, by L.A. Nessov, in 1987.

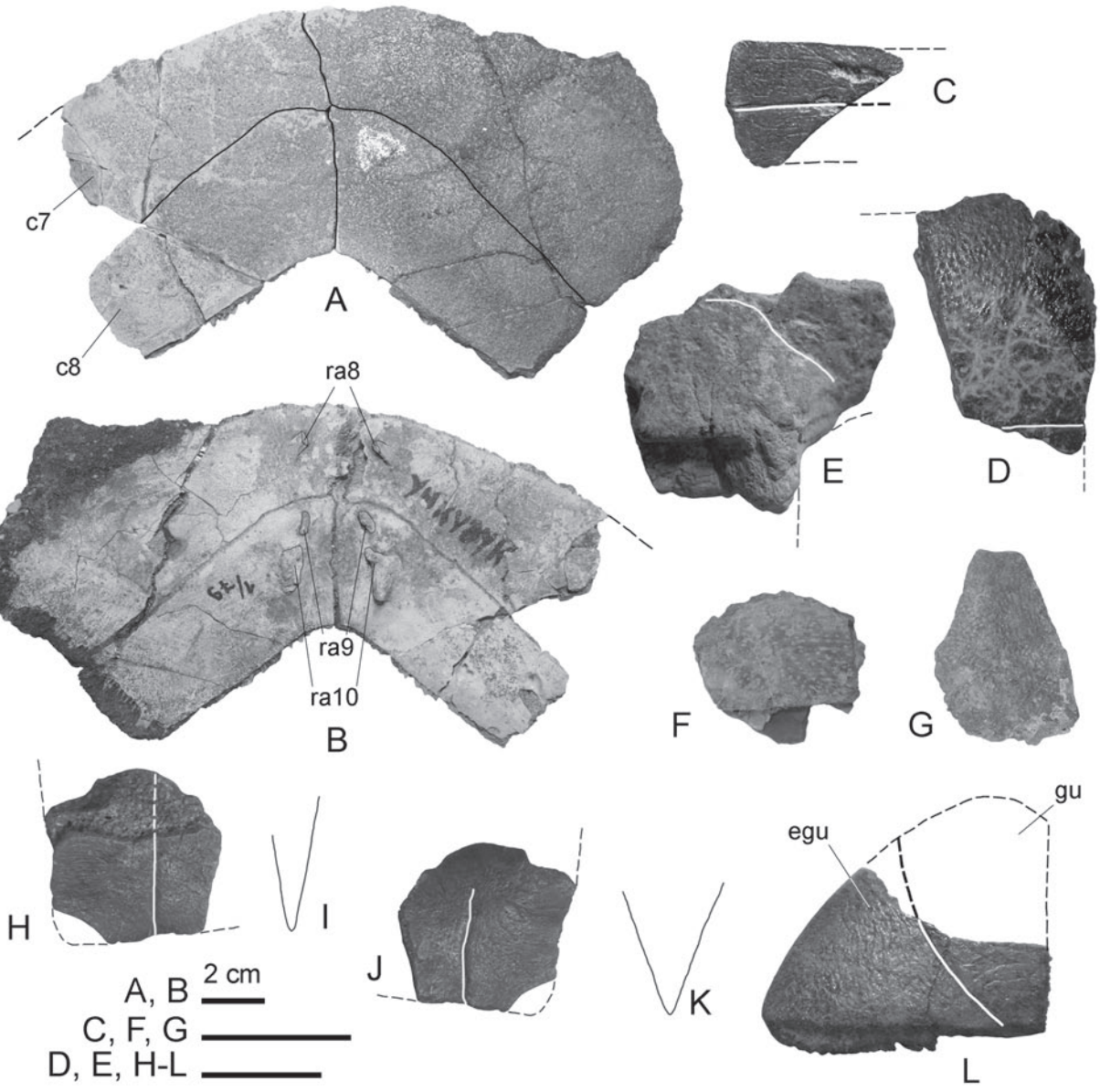

Fig. 6. *Shachemys*, shell fragments: A, B – ZIN PH 1/79, *Shachemys ancestralis*, complete left and right costals 7+8, Uchkuduk, Central Kyzylkum, Uzbekistan; Bissekty Formation, late Turonian: A – dorsal view; B – ventral view; C – ZIN PH 1/120, *Shachemys* sp. indet. 1, distal fragment of even costal, Altyntau, southern Altyntau Range, Central Kyzylkum, Uzbekistan; ?Late Cretaceous; D, E – *Shachemys* sp. indet. 2, shell fragments, Shatyrtyube II, Central Kyzylkum, Uzbekistan; Santonian: D – ZIN PH 2/110, fragment of bridge peripheral in dorsal view; E – ZIN PH 1/110, fragment of left hypoplastron in ventral view; F, G – ZIN PH 1, 2/143, *Shachemys* sp. indet. 3, undetermined shell fragments in external view, Shorsu, interfluves of Isfara and Shorsu Rivers, Tajikistan; Yalovach Formation, early Santonian: F – ZIN PH 1/143; G – ZIN PH 2/143; H–K – ZIN PH 1/109, *Shachemys* sp. indet. 4, fragment of left peripheral 8, Zenge Kurgan III, Khorezm Province, Uzbekistan; ?Bissekty Formation, Turonian: H – dorsal view; I – cross section at posterior border; J – ventral view; K – cross section at anterior border; L – ZIN PH 1/121, *Shachemys* sp. indet. 5, fragment of right epiplastron in ventral view, unknown locality 2 (AIG-1 local site), probably, Central Kyzylkum, Uzbekistan. A–H, J, L – photograps; I, K – drawings. See Figure 3 for abbreviations and designations.

Remarks. These specimens are assigned to *Shachemys* based on sculpturing of the shell with small dots.

***Shachemys* sp. indet. 3**
(Fig. 6F, G)

Material. ZIN PH 1/143 and 2/143, undetermined shell fragments from Shorsu, Tajikistan.

Remarks. These specimens are assigned to *Shachemys* based on a sculpturing of the shell with small dots.

***Shachemys* sp. indet. 4**
(Fig. 6H–K)

Material. ZIN PH 1–7/109, seven isolated shell fragments from Zenge Kurgan III, Uzbekistan, collected by URBAC expedition in 2004.

Remarks. These specimens are assigned to *Shachemys* based on a sculpturing of the shell with small dots.

***Shachemys* sp. indet. 5**
(Fig. 6L)

Material. ZIN PH 1/121, a posterior part of the right epiplastron from unknown locality (AIG-1 local site), probably, Central Kyzylkum, Uzbekistan.

Description and remarks. The epiplastron has a straight posterior border with a hinged surface (indicating presence of the epi-hyoentoplastral hinge); the sculpturing of the plate surface is with small dots (characters of *Shachemys*). Absence of the anterior part of the epiplastron does not allow species determination.

Adocidae incertae sedis

"*Adocus*" *orientalis* Gilmore, 1931
(excl. "*A*". *kazachstanica* Chkhikvadze, 1973)
(Fig. 7)

Adocus orientalis: Gilmore 1931, p. 220, fig. 2.
?*Adocus*: Khosatzky and Nessov 1977, p. 118.
"*Adocus*" *orientalis*: Sukhanov 2000, p. 333.

Holotype. AMNH 6356, anterior half of the plastron; Telegraph Line Camp, Irdin Manha, Inner Mongolia, China; Irdin Manha Formation, Late Eocene.

Material. PIN 5421/1, anterior part of the plastron; PIN 5421/2, left epiplastron; PIN 5421/3, partial left epiplastron of "*Adocus*" *orientalis*. The material was collected in Ergil Obo, Mongolia, by the Joint Soviet-Mongolian Paleontological Expedition in 1969–1973.

Differential diagnosis. "*Adocus*" *orientalis* can be differentiated from Cretaceous species of *Adocus* by sculpturing of the shell surface with dots (see Introduction). It can be differentiated from "*A*". *kazachstanica* by bigger size, epiplastra relatively longer and narrower anteriorly, gulars wider anteriorly than posteriorly, bigger extragulars with longer medial borders, narrower inframarginals, which are distant from plastron-carapace suture. It can be differentiated from Paleogene species of *Adocus* from North America: from *A. annexus* by narrower inframarginals; from *A. onerosus* by relatively longer epiplastra and wider entoplastron; from *A. substricta* by bigger extragulars, pectorals overlapping on to entoplastron and narrower inframarginals.

Description. PIN 5421/1 (Fig. 7A), the anterior part of the plastron with both epiplastra, almost complete entoplastron and partial hyoplastra is from an individual with an estimated shell length of about 55 cm. The epiplastra are elongate, make up about half of the length of the anterior plastral lobe. The anterior borders of the epiplastra are relatively wide (slightly wider than the length of the epiplastral symphysis). The entoplastron is diamond-shaped, wider than long. The gulars are relatively wide (their anterior width is about equal to the length of the epiplastral symphysis), narrowed posteriorly and have a waist in the posterior thirds of their length (in the type specimen of "*A*". *orientalis* the gulars are more narrowed posteriorly without a waist and with almost straight gular-extragular sulci, Fig. 7F). The gulars overlap the entoplastron. The extragulars are relatively small, covering about 1/4 of the external surface of the epiplastra, with long medial borders (their medial length is about equal to the length of the epiplastral symphysis); lateral borders of the extragulars are strongly elongated and extracted posteriorly. The extragulars of the type specimen of "*A*". *orientalis* are slightly shorter in the lateral borders (Fig. 7F). The humeral-pectoral sulcus intersects the entoplastron. As reconstructed, the pectorals are longer medially than laterally, forming a waist at the lateral third of their width. Inframarginals are represented by inframarginals 1–3 on the left hyoplastron and parts of inframarginals 1 and 2 on the right hyoplastron. Inframarginals 1 and 2 are completely restricted to

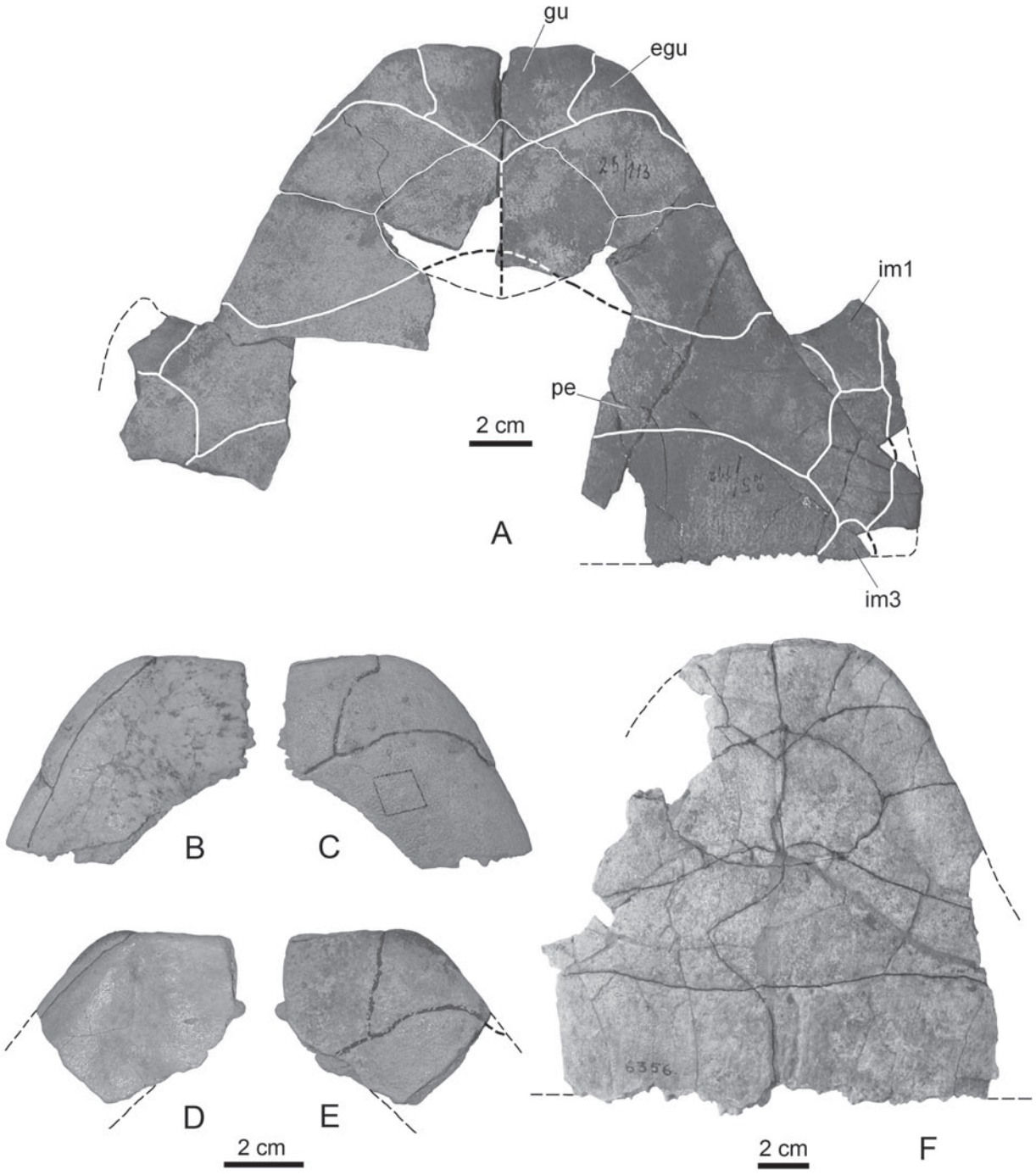

Fig. 7. "*Adocus*" *orientalis*, shell fragments: A–E – fragments of plastron, Ergil Obo, Dornogov Aimag, Mongolia; Ergiliin Dzo Formation, Late Eocene: A – PIN 5421/1, anterior part of the plastron in ventral view; B, C – PIN 5421/2, left epiplastron: B – dorsal view; C – ventral view; D, E – PIN 5421/3, partial left epiplastron: D – dorsal view; E – ventral view; F – AMNH 6356, anterior half of plastron in ventral view, Telegraph Line Camp, Irdin Manha, Inner Mongolia, China; Irdin Manha Formation, Late Eocene. Photographs. See Figure 3 for abbreviations and designations.

the hyoplastra, whereas inframarginal 3 extended on to the hypoplastron. The observable inframarginals are slightly distant from the plastron-carapace suture and do not extend on to the peripherals. The midline sulcus is almost straight on the preserved part of the plastron. The skin-scale sulcus lies along the free edge of the anterior lobe.

PIN 5421/2 (Fig. 7B, C) and PIN 5421/3 (Fig. 7D, E), two left epiplastra, differ from epiplastra of PIN 5421/1 in shape of the gulars and gular-extragular sulci. The gular is more narrowed posteriorly in PIN 5421/2 and less narrowed in PIN 5421/3. The gular-extragular sulcus is S-shaped in PIN 5421/2 and straight in PIN 5421/3.

Remarks. In general, morphology of the described specimens well corresponds to the type of "*A*". *orientalis*, which allow us to assign them to this species. Chkhikvadze (1990 and references therein) sinonymized "*A*". *orientalis* and "*A*". *kazachstanica* from the Middle Eocene of Kazakhstan. However, "*A*". *orientalis* is different from "*A*". *kazachstanica* in size, shape of epiplastra, entoplastron, gulars and extragulars, shape and position of inframarginals (see Diagnosis). For this reason, we suggest to consider these species as separate until new findings.

Distribution. Late Eocene of Mongolia and China.

cf. "*Adocus*" *orientalis*
(Fig. 8A, B)

Dermatemydids, gen. indet.: Gilmore 1931, p. 222.

Material. AMNH 6712, hyoplastron and hypo+xiphiplastron from North Mesa, Inner Mongo-

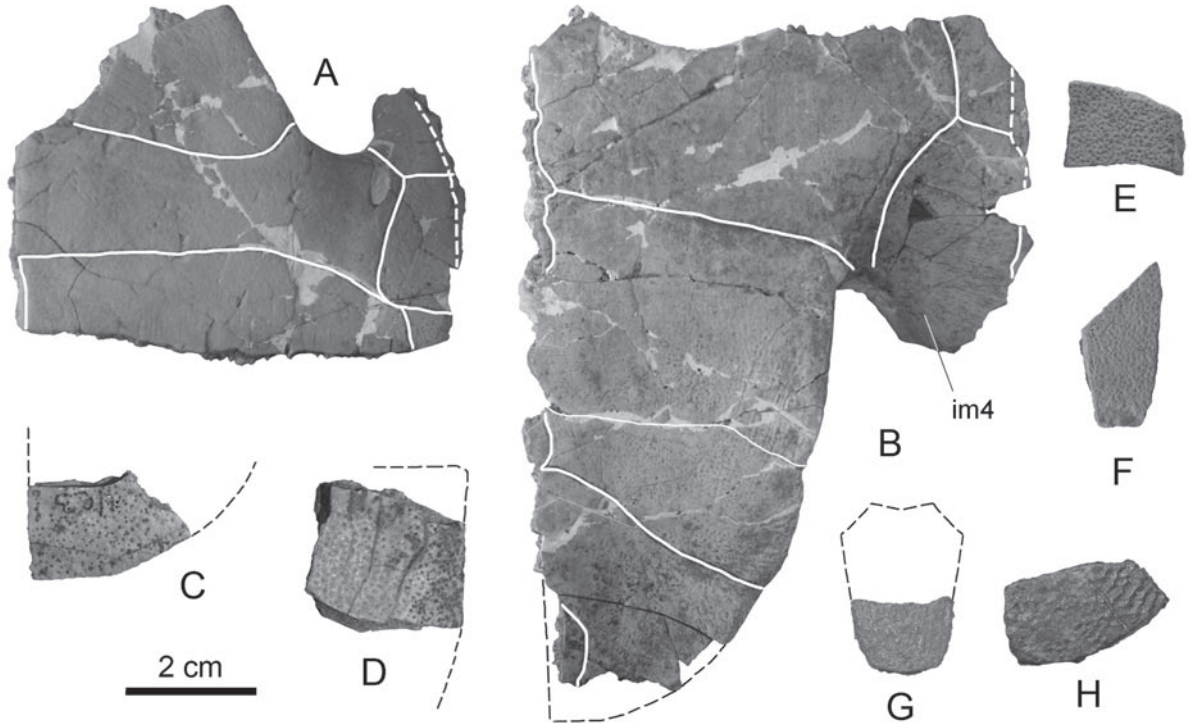

Fig. 8. "*Adocus*", shell fragments: A, B – AMNH 6712, cf. "*Adocus*" *orientalis*, fragments of plastron, North Mesa, Chimney Buttle Quarry, Shara Murun region, Inner Mongolia, China; Ulan Shireh Formation, Late Eocene: A – left hyoplaston in ventral view; B – left hypo+xiphiplastron in ventral view; C, D – "*Adocus*" sp. indet. 1, fragments of left xiphiplastron in ventral view, Aktau, southern Dzhungar Alatau Ridge, Ili River Basin, Almaty Province, south-eastern Kazakhstan; ?Aktau Formation, ?Oligocene: C – ZIN PH 1/93; D – ZIN PH 2/93; E, F – AMNH 6723, "*Adocus*" sp. indet. 2, two undetermined shell fragments in external view, Urtyn Obo, East Mesa, Shara Murun region, Inner Mongolia, China; Ulan Gochu Formation, Early Oligocene; G, H – Adocidae indet., shell fragments, Kokcha I, Kyzylkum, Uzbekistan; Beshtyube Formation(?), early(?) Turonian: G – ZIN PH 1/114, fragment of neural in dorsal view; H – ZIN PH 2/114, undetermined shell fragment in external view. Photographs. See Figure 3 for abbreviations and designations.

lia, China, mentioned by Gilmore (1931) as part of his Dermatemydids, gen. indet.

Description. The left hyoplastron (Fig. 8A) and left hypo+xiphiplastron (Fig. 8B) are, probably, from one individual with an estimated shell length of about 35 cm. General proportions of the plastral plates and scalation correspond to those of *Adocus* spp. The posterior lobe is rounded. Internally, xiphiplastron bears an oval-shaped fossa for pelvic attachment. The humeral-pectoral sulcus crosses the entoplastron-hyoplastron border. The pectoral is almost equal in its medial and lateral length and with a weak waist at the lateral third of its width. The femoral-anal sulcus is slightly S-shaped. The inframarginals are represented by a complete row of four scales. They are relatively narrow with lateral borders lying close to the plastron-carapace suture. Inframarginal 4 is about twice bigger than the anterior ones. The midline sulcus is slightly sinuous beginning with abdominal to the anal. The skin-scale sulcus lies along the free edge of the plastral lobes. The sculpturing of the shell surface is with small dots.

Remarks. Gilmore (1931) assigned "incomplete plastral bones" to "Dermatemydids, gen. indet." Attribution of these materials to "*Adocus*" is based on a sculpturing of the shell with small dots and shape of the anterior part of the hyoplastron. This "*Adocus*" is similar to "*Adocus*" *orientalis* in general outline and scalation of the plastron (extension of the pectorals onto the entoplastron, wide inframarginals, sinuous midline sulcus). However, here we refrain from attribution of cf. "*Adocus*" *orientalis* to "*Adocus*" *orientalis* until more information is available.

"*Adocus*" sp. indet. 1
(Fig. 8C, D)

Material. ZIN PH 1/93 and 2/93, two fragments of the left xiphiplastron; ZIN PH 3/93, undetermined shell fragment. The specimens were collected in Aktau, south-eastern Kazakhstan, by N.N. Verzilin, in 1979.

Description and remarks. Fragments of the left xiphiplastron (possibly, from one individual) have no extension of the plastral scales (femoral or anal) onto the dorsal surface of the xiphiplastron. The skin-scale sulcus lies along the free edge of the xiphiplastron. All fragments have a sculpturing of the shell with small dots. These characters allow attribution of this material to *"Adocus"*.

"*Adocus*" sp. indet. 2
(Fig. 8E, F)

Material. AMNH 6723, two undetermined shell fragments from Urtyn Obo, Inner Mongolia, China.

Remarks. These fragments are assigned to "*Adocus*" based on a sculpturing of the shell surface with small dots.

Adocidae indet.
(Fig. 8G, H)

Material. ZIN PH 1/114, a fragment of the neural; ZIN PH 2–4/114, three undetermined shell fragments. The material was collected from Kokcha I, Uzbekistan, by L.A. Nessov, in 1974.

Remarks. These fragments are assigned to Adocidae based on sculpturing of their surface with small pits. More precise determination is impossible.

DISCUSSION

Our review of all known records of adocid turtles in Asia includes data from 88 localities (see Table 1). Records from 14 localities are completely new, whereas records from 74 localities are based on published data (in some cases with new observations of materials). The taxonomic status of the previous records from 16 localities is changed according to modern systematics based on published data, new materials and/or observations. Records from 34 localities, published without descriptions and illustrations (see "Review of records..."), still need a confirmation.

The new records include *Adocus* sp. indet. 1–4, *Shachemys ancestralis, Shachemys* sp. indet. 1–5, cf. "*Adocus*" *orientalis,* "*Adocus*" sp. indet. 1 & 2, and Adocidae indet. Records of Adocidae ("*Adocus*") from the Oligocene of Kazakhstan (Aktau) and China (Urtyn Obo) are reported here for the first time. Besides that, one of the important results of our study is the description of the material of "*Adocus*" *orientalis* from the Late Eocene of Mongolia, mentioned by Sukhanov (2000). Primarily, this species was described from the Late Eocene of Inner Mongolia (Gilmore 1931), but later "*A*". *kazachstanica* from the Middle Eocene of Kazakhstan was placed in its synonymy by Chkhikvadze (1990 and refer-

Table 1. Numbers of published and new records, taxonomic status changes, descriptions of new material and observations provided by this study.

No.	Locality	Published record	New record	Status change	New material or observations
1	Abdurassaj & Syuren'atau	+			
2	Akkurgan	+			
3	Akkurgan-Boltyk	+			
4	Aktau		+		+
5	Altyntau		+		+
6	Alymtau	+		+	+
7	Amagimi Dam of Mifune	+			
8	Amtgai	+			+
9	Aravan II	+			
10	Ayazkala	+			
11	Baga Tarjach	+			
12	Bain Shire	+			
13	Ban Lam Thoy	+		+	+
14	Ban Saphan Hin	+			
15	Baybishe I	+			
16	Baykhozha	+			
17	Bayshin Tsav	+			
18	Baytuma	+			
19	Burkhant	+		+	+
20	Buroynak	+		+	+
21	Changet IV	+			
22	Chelpyk	+		+	+
23	Daugyztau I	+			
24	Dersnii Khuduk	+			
25	Dzharakuduk I	+			
26	Dzharakuduk II	+			
27	Dzhurtas	+			
28	Dzhylga	+			
29	Dzun Shakhai	+			
30	Ergil Obo	+			
31	Gaofengshan	+			
32	Itemir	+			
33	Kan	+			
34	Kansai	+			
35	Karachadalisay	+			
36	Karakul	+			
37	Karamurun II	+		+	+
38	Karatepa	+			
39	Katsuyama	+			
40	Kazgurt	+			
41	Khara Khutul		+		+
42	Khodzhakul I	+		+	+
43	Khodzhakul II	+			
44	Khodzhakul III	+			
45	Khodzhakulsay	+		+	+

Table 1 (Continued).

No.	Locality	Published record	New record	Status change	New material or observations
46	Khongil		+		+
47	Kokcha I		+		+
48	Koskuduk	+			
49	Kuji City	+			
50	Kulkala	+			
51	Kulkuduk II	+			
52	Kylodzhun I	+			
53	Kyrkkuduk I	+		+	+
54	Kyzylpilyal' I	+			
55	Kyzylpilyal' II	+			
56	Lyagan	+		+	+
57	North Mesa		+		+
58	Ongon Ulan Ula	+		+	+
59	Phu Kum Khao	+			
60	Phu Wat	+			
61	Pitnyak	+			
62	Shakh-Shakh	+			
63	Shatyrtyube I	+			
64	Shatyrtyube II		+		+
65	Sheikhdzheili II	+			
66	Sheichdzheili III	+			
67	Shejh-Aryk	+			
68	Shine Us Khuduk	+		+	+
69	Shine Usny Tolgod	+			
70	Shiramine-mura	+		+	+
71	Shokawa	+		+	+
72	Shorsu		+		+
73	Shurab	+			
74	Suining	+			
75	Syuk-Syuk	+			
76	Tamdy-Truba	+		+	+
77	Telegraph Line Camp	+			
78	Tsagan Teg		+		+
79	Tyul'keli	+			
80	Uchkuduk		+		+
81	Urtyn Obo		+		+
82	Ushyin Khuduk	+			
83	Zaisan depression	+			
84	Zenge Kurgan III		+		+
85	Zhaldyrbas Takyr	+			
86	Zumuratsho	+		+	+
87	Unknown locality 1		+		+
88	Unknown locality 2		+		+
Total		74	14	16	31

Table 2. Temporal and geographic distribution of adocid record in Asia. First number refers to locality and number in parenthesis marks number of adocid taxa in the locality (see "Review of records..." for names of the localities and data on taxa). Records with uncertain age (5, 18, 23, 29, 43, 48, 50, 69, 85, 87, 88) are not shown.

<table>
<tr><th>Age</th><th>Middle Asia</th><th>Kazakhstan</th><th>Mongolia</th><th>China</th><th>Laos & Thailand</th><th>Japan</th><th>Total</th></tr>
<tr><td>Oligocene</td><td rowspan="4"></td><td>4(1)</td><td></td><td>81(1)</td><td rowspan="12"></td><td rowspan="4"></td><td>2</td></tr>
<tr><td>Eocene</td><td>83(1)</td><td>30(1)</td><td>57(1), 77(1)</td><td>4</td></tr>
<tr><td>Paleocene</td><td>28(1)</td><td rowspan="2"></td><td rowspan="11"></td><td>1</td></tr>
<tr><td>Maastrichtian</td><td></td><td>0</td></tr>
<tr><td>Campanian</td><td rowspan="3">1(1), 9(1), 21(1) 34(2), 55(2), 56(1), 63(2), 64(1), 67(1), 72(1), 76(1), 86(2)</td><td rowspan="3">2(2), 3(2), 6(1), 15(2), 16(1), 20(2), 27(2), 40(1), 53(1), 62(3), 75(2)</td><td>11(1)</td><td rowspan="6">59</td></tr>
<tr><td>Santonian</td><td rowspan="4">8(1), 12(1), 17(1), 19(1), 24(1), 41(1), 46(1), 58(1), 68(1), 78(1), 82(1)</td><td rowspan="2">7(2),
49(1)</td></tr>
<tr><td>Coniacian</td><td>61(1)</td><td rowspan="2">79(1)</td></tr>
<tr><td>Turonian</td><td>25(1), 26(2), 37(1), 47(1), 51(1), 73(1), 80(1), 84(1)</td><td rowspan="5"></td></tr>
<tr><td>Cenomanian</td><td>10(1), 22(1), 32(2), 33(1), 35(1), 38(1), 42(1), 44(1), 45(2), 56(1), 65(2), 66(1)</td><td rowspan="4"></td><td rowspan="4">9</td></tr>
<tr><td>Albian</td><td>52(1)</td><td rowspan="4"></td><td rowspan="2">13(1), 14(1)</td></tr>
<tr><td>Aptian</td><td>36(1)</td><td rowspan="3">39(1),
70(1), 71(1)</td></tr>
<tr><td>Neocomian</td><td rowspan="2"></td><td>59(1), 60(1)</td></tr>
<tr><td>Late Jurassic</td><td>31(1), 74(1)</td><td></td><td></td><td>2</td></tr>
<tr><td>Total</td><td>35</td><td>15</td><td>13</td><td>5</td><td>4</td><td>5</td><td>77</td></tr>
</table>

Table 3. Distribution of the adocid taxa by localities of Asia.

No.	Locality	*Adocus* (incl. "*Adocus*")	*Shachemys*	*Ferganemys*	*Isanemys*	*Yehguia*	Gen. indet.
1	Abdurassaj & Syuren'atau		+				
2	Akkurgan	+	+				
3	Akkurgan-Boltyk	+	+				
4	Aktau	+					
5	Altyntau		+				
6	Alymtau		+				
7	Amagimi Dam of Mifune	+	+				
8	Amtgai	+					
9	Aravan II		+				
10	Ayazkala			+			
11	Baga Tarjach	+					
12	Bain Shire						+
13	Ban Lam Thoy		+				
14	Ban Saphan Hin		+				
15	Baybishe I	+	+				
16	Baykhozha						+
17	Bayshin Tsav	+					
18	Baytuma	+					
19	Burkhant	+					
20	Buroynak	+	+				
21	Changet IV		+				
22	Chelpyk			+			
23	Daugyztau I		+				
24	Dersnii Khuduk	+					
25	Dzharakuduk I		+				
26	Dzharakuduk II	+	+				
27	Dzhurtas	+					
28	Dzhylga	+					
29	Dzun Shakhai						+
30	Ergil Obo	+					
31	Gaofengshan					+	
32	Itemir	+		+			
33	Kan						+
34	Kansai	+	+				
35	Karachadalisay						+
36	Karakul	+					
37	Karamurun II		+				
38	Karatepa			+			
39	Katsuyama	+					
40	Kazgurt		+				
41	Khara Khutul	+					
42	Khodzhakul I	+					
43	Khodzhakul II			+			
44	Khodzhakul III						+

Table 3 (Continued).

No.	Locality	*Adocus* (incl. "*Adocus*")	*Shachemys*	*Ferganemys*	*Isanemys*	*Yehguia*	Gen. indet.
45	Khodzhakulsay	+		+			
46	Khongil	+					
47	Kokcha I						+
48	Koskuduk		+				
49	Kuji City	+					
50	Kulkala						+
51	Kulkuduk II						+
52	Kylodzhun I			+			
53	Kyrkkuduk I		+				
54	Kyzylpilyal' I	+	+				
55	Kyzylpilyal' II	+	+				
56	Lyagan		+				
57	North Mesa	+					
58	Ongon Ulan Ula						+
59	Phu Kum Khao				+		
60	Phu Wat				+		
61	Pitnyak						+
62	Shakh-Shakh	+	+				
63	Shatyrtyube I	+	+				
64	Shatyrtyube II		+				
65	Sheikhdzheili II	+		+			
66	Sheichdzheili III						+
67	Shejh-Aryk						+
68	Shine Us Khuduk	+					
69	Shine Usny Tolgod						+
70	Shiramine-mura						+
71	Shokawa						+
72	Shorsu		+				
73	Shurab		+				
74	Suining					+	
75	Syuk-Syuk	+	+				
76	Tamdy-Truba		+				
77	Telegraph Line Camp	+					
78	Tsagan Teg	+					
79	Tyul'keli		+				
80	Uchkuduk		+				
81	Urtyn Obo	+					
82	Ushyin Khuduk	+					
83	Zaisan depression	+					
84	Zenge Kurgan III		+				
85	Zhaldyrbas Takyr		+				
86	Zumuratsho	+	+				
87	Unknown locality 1	+					
88	Unknown locality 2		+				
Total		40	36	8	2	2	16

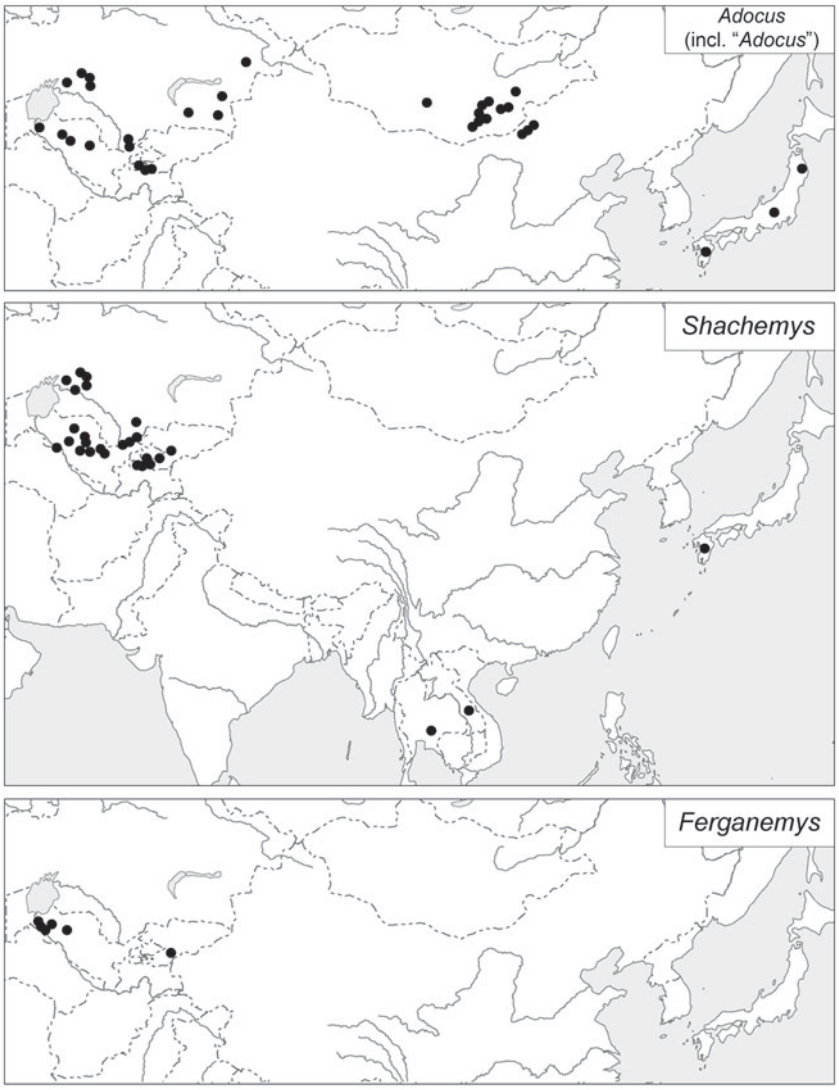

Fig. 9. Map showing the geographic distribution of the genera *Adocus* (incl. "*Adocus*"), *Shachemys* and *Ferganemys* in Asia. See text for explanation.

ences therein). Based on study of the new and type material of "*A*". *orientalis*, we emended diagnosis of this species and removed "*A*". *kazachstanica* from its synonymy. Material mentioned by Gilmore (1931) as part of his Dermatemydids, gen. indet. from the Late Eocene of Inner Mongolia is described here as cf. "*Adocus*" *orientalis*.

Reassessment of the published data on Asian adocids allows us to change taxonomic status of some previous findings. *Shineusemys planus* and *Adocoides amtgai* previously placed into their own genera (Sukhanov 2000; Sukhanov and Narmandakh 2006) are considered here within *Adocus* sensu lato, although this issue needs additional study. We also reassess material on *Mlynarskiella mariani* as Shachemydinae indet. and suggest that *M. mariani* be considered a nomen dubium. If our determination is correct, this is the first record of Shachemydinae from Mongolia.

Our analysis of adocid records in Asia (see Table 2) shows that most of them are from Middle Asia (35 localities), Kazakhstan (15) and Mongolia (13); China and Japan has five localities each, Laos+Thailand have four localities. The geological distribution of the records (localities) is as follows: Late Jurassic – 2; Early Cretaceous – 9; Cenomanian – Campanian – 59; Maastrichtian – 0; Paleocene – 1; Eocene – 4; Oligocene – 2.Distribution of adocid genera by localities of Asia (see Table 3) shows that most of them belong to *Adocus* (incl. "*Adocus*"; 40) and *Shachemys* (36). Number of records for other genera is rarer: *Ferganemys* (8); *Isanemys* (2) and *Yehguia* (2). As was mentioned earlier (Danilov et al. 2007; Syromyatnikova and Danilov 2008), known distribution of *Shachemys* is restricted to coastal areas of ancient Asia, whereas *Adocus* seems to have latidudinal distribution (Fig. 9). Distribution of other adocid genera is more local.

According to recent data on paleoclimatology, the latidudinal distribution of *Adocus* in Asia and North America may be connected with the zone of subtropical humid climate with mean annual temperature of at least 15 °C (Semikhatov and Chumakov 2004, Brinkman and Tarduno 2005). Adocidae are known in Asia from the Late Jurassic to Campanian (Fig. 10)

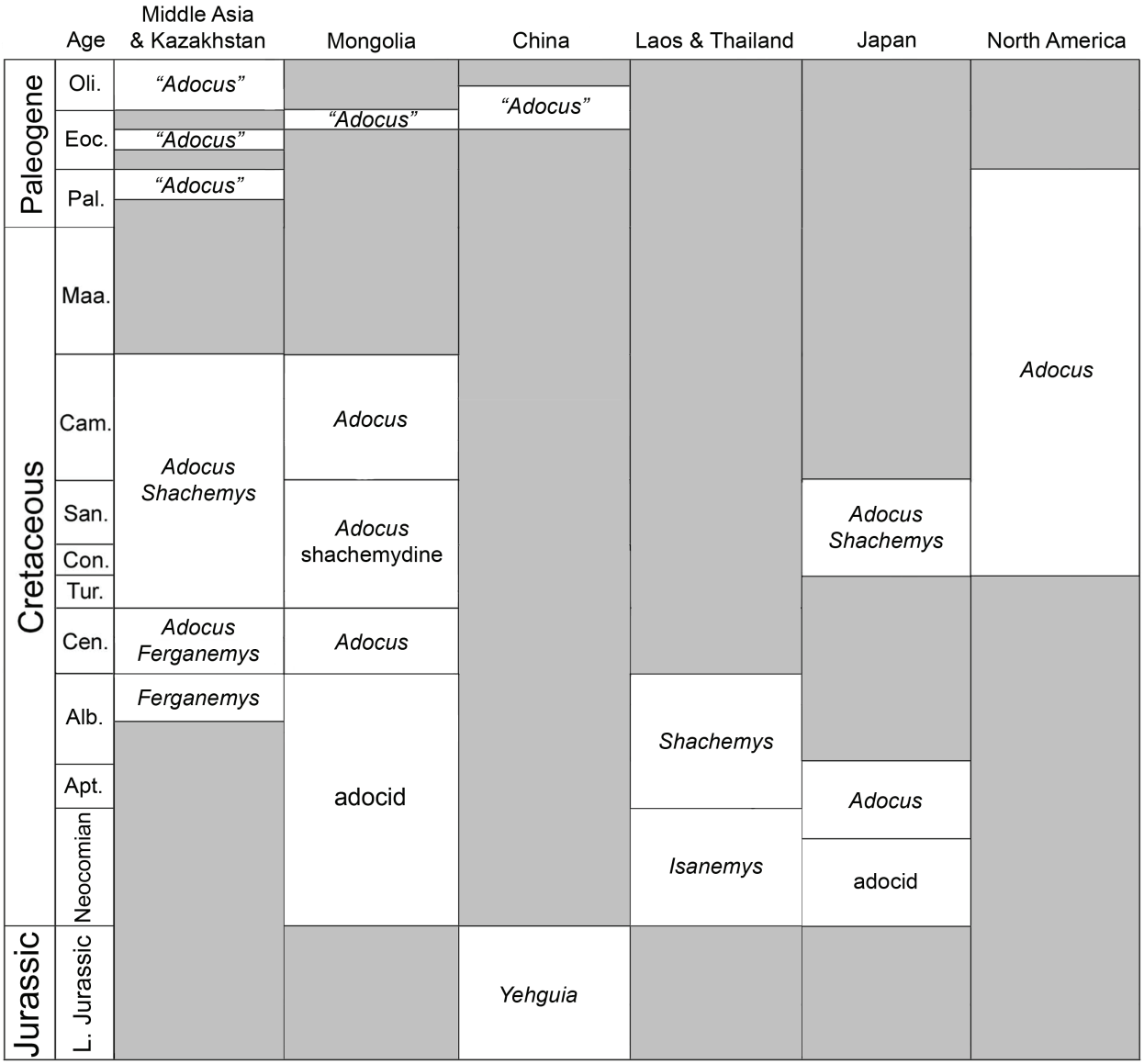

Fig. 10. Temporal and geographic distribution of Adocidae. Gaps in record are filled with grey. See text and Figure 2 for details of Asian records. Temporal distribution of adocids in North America is given according to Hutchison (2000).

and then disappeared until the Late Paleocene – Late Oligocene interval. The appearance of Adocidae ("*Adocus*") in Asia during the Late Paleocene can be explained by migration of *Adocus* from North America. This migration of *Adocus* via the Bering Land Bridge became possible due to the thermal maximum in the Late Paleocene and the progressively warming climate in high latitudes (Zachos et al. 2001). But this hypothesis needs a confirmation.

To summarize, our study presents a significant contribution to the knowledge about geographical and geological distribution of the adocid turtles in Asia. The adocid record is best documented from the Late Cretaceous of Middle Asia, where they reached their peak of diversity (Fig. 10). However, still there are many questions about early evolution of this group in other parts of Asia and relationships between Asian and American adocids.

ACKNOWLEDGMENTS

The authors thank members of the URBAC expeditions for help in collecting of part of the material described in this paper; IGD & EVS thank France de Lapparent de Broin (MNHN) for access to the turtle collection; IGD thanks Mark A. Norell, and Carl Mehling (AMNH); the authors thank D.Brinkman and R. Hirayama for reviewing the manuscript and useful comments. This study was done under financial support of grant of the Russian Foundation for Basic Research (08-05-00557-a) and grant of the President of the Russian Federation to the Leading Scientific Schools (NSh-4724.2010.4).

REFERENCES

Averianov A.O. 1997. Paleogene sea snakes from the eastern part of Tethys. *Russian Journal of Herpetology*, **4**: 128–142.

Averianov A.O. 2007. New records of azhdarchids (Pterosauria, Azhdarchidae) from the Late Cretaceous of Russia, Kazakhstan, and Central Asia. *Paleontologicheskii Zhurnal*, **41**(2): 73–79.

Averianov A.O. and Archibald J.D. 2005. Mammals from the Mid-Cretaceous Khodzhakul Formation, Kizylkum Desert, Uzbekistan. *Cretaceous Research*, **26**: 593–608.

Brinkman D.B. and Tarduno J.A. 2005. A Late Cretaceous (Turonian–Coniacian) high-latitude turtle assemblage from the Canadian Arctic. *Canadian Journal of Earth Science*, **42**: 2073–2080.

Chkhikvadze V.M. 1973. Tertiary turtles of the Zaisan Basin. Metsniereba, Tbilisi, 100 p. [In Russian]

Chkhikvadze V.M. 1976. New data on fossil turtles of Mongolia, China and eastern Kazakhstan. *Soobshcheniya Akademii Nauk Gruzinskoy SSR*, **82**(3): 745–748. [In Russian]

Chkhikvadze V.M. 1990. Paleogene Turtles of the USSR. Metsniereba, Tbilisi, 95 p. [In Russian]

Chkhikvadze V.M. 2008. Event geology: "Grand Coupure" in Kazakhstan at the Eocene-Oligocene border. Paleontological relics of nature – natural legasy: study, perspectives of investigations and problems of conservation. Materials of the International-Practical Conference (2–4 October 2008, Pavlodar): 112–117. [In Russian]

Chkhikvadze (Čkhikvadze) V.M. and Shuvalov V.F. 1988. The first find of Cretaceous chelonians in the Ekhingol Basin (Mongolia). *Acta Zoologica Cracoviensia*, **31**(18): 509–512.

Currie P.J. and Eberth D.A. 1993. Palaeontology, sedimentology and palaeoecology of the Iren Dabasu Formation (Upper Cretaceous), Inner Mongolia, People's Republic of China. *Cretaceous Research*, **14**: 127–144.

Danilov I.G. and Parham J.F. 2006. A redescription of '*Plesiochelys*' *tatsuensis* from the Late Jurassic of China, with comments on the antiquity of the crown clade Cryptodira. *Journal of Vertebrate Paleontology*, **26**: 573–580.

Danilov I.G. and Syromyatnikova E.V. 2008. New materials on turtles of the family Nanhsiungchelyidae from the Cretaceous of Uzbekistan and Mongolia, with a review of the nanhsiungchelyid record in Asia. *Proceedings of the Zoological Institute of the Russian Academy of Sciences*, **312**(1/2): 3–25.

Danilov I.G. and Syromyatnikova E.V. 2009a. Phylogenetic analysis of turtles of the superfamily Adocoidea. In: A.Yu. Rozanov, A.V. Lopatin and P.Yu. Parkhaev (Eds.). Modern Paleontology: Classical and New Methods – 2009. Paleontological Institute of the Russian Academy of Sciences, Moscow: 67–82. [In Russian]

Danilov I.G. and Syromyatnikova E.V. 2009b. Phylogeny of the extinct turtle clade Adocusia. Gaffney Turtle Symposium (17–18 October 2009, Drumheller, Canada). Drumheller, Canada: 44–51.

Danilov I.G., Syromyatnikova E.V. and Sukhanov V.B. 2007. Turtles of the genus *Shachemys* from the Upper Cretaceous of Asia. In: A.Yu. Rozanov, A.V. Lopatin and P.Yu. Parkhaev (Eds.). Modern Paleontology: Classical and New Methods – 2007. Paleontological Institute of the Russian Academy of Sciences, Moscow: 59–72. [In Russian]

Gilmore C.W. 1919. Reptilian faunas of the Torrejon, Puerco, and underlying Upper Cretaceous formations of San Juan County, New Mexico. *U.S. Geological Survey Professional Paper*, **119**: 1–75.

Gilmore C.W. 1931. Fossil turtles of Mongolia. *Bulletin of the American Museum of Natural History*, **59**: 213–257.

Hay O.P. 1908. The Fossil Turtles of North America. Carnegie Institution of Washington, Washington D.C., 568 p.

Hay O.P. 1910. Descriptions of eight new species of fossil turtles from west of the one hundredth meridian. *Proceedings of the United States National Museum*, **38**: 307–326.

Hirayama R. 1998. Fossil turtles from the Mifune Group (Late Cretaceous) of Kumamoto Prefecture, Western Japan. In: Report of the Research on the Distribution of Important Fossils in Kumamoto Prefecture. Dinosaurs from the Mifune Group, Kumamoto Prefecture, Japan. Mifune Town Education Board: 85–99. [In Japanese]

Hirayama R. 2000. Fossil turtles. In: H. Matsuoka (Ed.). Fossils of Kuwajima "Kaseki-kabe" (Fossil-bluff): Scientific report on a Neocomian (Early Cretaceous) fossil assemblage from the Kuwajima Formation, Tetori Group, Shiramine, Ishikawa, Japan. Shiramine Village Board of Education, Ishikawa Prefecture, Japan: 75–92. [In Japanese with English abstract]

Hirayama R. (Ed.) 2001. Dinosaur fossils from Chongqing Natural History Museum. RKB-Mainichi Broadcasting Corporation, Fukuoka, 104 p. [In Japanese]

Hirayama R. 2002. Preliminary report of the fossil turtles from the Kitadani Formation (Early Cretaceous) of the Tetori Group of Katsuyama, Fukui Prefecture, Central Japan. *Memoir of the Fukui Prefectural Dinosaur Museum*, **1**: 29–40. [In Japanese]

Hirayama R. 2010. Nonmarine turtles from the Early Cretaceous Tetori Group of Kasekikabe of Hakusan City, Ishikawa Prefecture, Central Japan. In: Scientific report on fossils from the Kuwajima Formation, Tetori Group, of Kuwajima "Kaseki-kabe", Hakusan City, Ishikawa, Japan. Hakusan City Board of Education, Ishikawa Prefecture, Japan: 19–24. [In Japanese]

Hirayama R., Brinkman D.B. and Danilov I.G. 2000. Distribution and biogeography of non-marine Cretaceous turtles. *Russian Journal of Herpetology*, **7**(3): 181–198.

Hirayama R., Zhong Y., Di Y., Yonezawa T. and Hasegawa M. 2009. A new nanhsiungchelyid turtle from Late Cretaceous of Guandong, China. Gaffney Turtle Symposium (17–18 October 2009, Drumheller, Canada). Drumheller, Canada: 72.

Hirayama R., Kobayashi Y., Sonoda T. and Sasaki K. 2010. Preliminary report of terrestrial vertebrates from the Late Cretaceous Tamagawa Formation of the Kuji Group of Kuji, Iwate Prefecture, eastern Japan. *Journal of Fossil Research*, **42**: 74–82. [In Japanese with English abstract]

Hutchison J.H. 2000. Diversity of Cretaceous turtle faunas of Eastern Asia and their contribution to the turtle faunas of North America. *Paleontological Society of Korea Special Publication*, **4**: 27–38.

Hutchison J.H. and Bramble D.M. 1981. Homology of the plastral scales of the Kinosternidae and related turtles. *Herpetologica*, **37**: 73–85.

Jerzykiewicz T. and Russell D.A. 1991. Late Mesozoic stratigraphy and vertebrates of the Gobi Basin. *Cretaceous Research*, **12**: 345–377.

Khosatzky L.I. 1976. New representative of trionychids from the Late Cretaceous of Mongolia. *Gerpetologiya. Kubanskiy Gosudarstvennyy Universitet. Nauchnye Trudy*, **218**: 3–19. [In Russian]

Khosatzky L.I. 1999. Turtles – trionychids of the Cretaceous of Mongolia. Voprosy Paleontologii, **11**: 141–149. [In Russian]

Khosatzky L.I. and Nessov L.A. 1977. Turtles of the genus *Adocus* from the Late Cretaceous in the USSR. *Trudy Zoologicheskogo Instituta AN SSSR*, **74**: 116–119. [In Russian]

Kordikova E.G. and Mavrin A.V. 1996. Stratigraphy and Oligocene-Miocene mammalian biochronology of the Aktau Mountains, Dzhungarian Alatau Range, Kazakhstan. *Palaeovertebrata*, **25**(2–4): 141–174.

Kuznetsov V.V. 1976. Freshwater turtles from the Senonian deposits of the north-eastern part of the Aral Sea region. *Paleontologicheskiy Zhurnal*, **4**: 125–127. [In Russian]

Kuznetsov V.V. and Shilin P.V. 1983. Late Cretaceous turtles from Baibishe (north-east Pre-Aralia). *Izvestya AN Kazakhskoy SSR, Seriya Biologicheskaya*, **6**: 41–44. [In Russian]

Lapparent de Broin F. de. 2004. A new Shachemydinae (Chelonii, Cryptodira) from the Lower Cretaceous of Laos: preliminary data. *Comptes Rendus Palevol*, **3**: 387–396.

Lucas S.G., Bayshashov B.U., Tyutkova L.A., Zhamangara A.K. and Aubekerov B.Z. 1997. Mammalian biochronology of the Paleogene-Neogene boundary at Aktau Mountain, eastern Kazakhstan. *Paläontologische Zeitschrift*, **71**(3–4): 305–314.

Meng J. and McKenna M.C. 1998. Faunal turnovers of Palaeogene mammals from the Mongolian Plateau. *Nature*, **394**: 364–367.

Nakajima Y., Sakurai K. and Hirayama R. 2011. Turtle fossils in Hobetsu Museum. *The Bulletin of the Hobetsu Museum*, **26**: 1–34.

Narmandakh P. 1985. A new species of *Adocus* from the Late Cretaceous of Mongolia. *Paleontologicheskiy Zhurnal*, **2**: 85–93. [In Russian]

Narmandakh P. 1991. Iskopaemye cherepakhi Mongol'skoy Narodnoy Respubliki [Fossil turtles of the Mongolian People's Republic]. Abstract of Candidate Dissertation. Paleontological Institute, Moscow, 25 p. [In Russian]

Nessov L.A. 1981. On the turtle of the family Dermatemydidae from the Cretaceous of Amur River Basin and some other rare findings of remains of ancient turtles of Asia. In: L.Ya. Borkin (Ed.). Herpetological Investigations in Siberia and the Far East. Zoological Institute, Academy of Sciences of the USSR, Leningrad: 69–73. [In Russian]

Nessov L.A. 1985 (1984). Data on Late Mesozoic turtles from the USSR. *Studia Palaeochelonologica*, **1**: 215–223.

Nessov L.A. 1986. Some Late Mesozoic and Paleocene turtles of Soviet Middle Asia. *Studia Palaeochelonologica*, **2**: 7–22.

Nessov L.A. 1987. On some Mesozoic turtles of the Soviet Union, Mongolia and China, with comments on systematics. *Studia Palaeocheloniologica*, **2**: 87–102.

Nessov L.A. 1995a. On some Mesozoic turtles of the Fergana Depression (Kyrgyzstan) and Dzhungar Alatau Ridge (Kazakhstan). *Russian Journal of Herpetology*, **2**: 134–141.

Nessov L.A. 1995b. Dinozavry Severnoj Evrazii: novye dannye o sostave kompleksov, ekologii i paleogeografii [Dinosaurs of Northern Eurasia: New Data about Assemblages, Ecology and Palaeogeography]. Saint Petersburg State University, Saint Petersburg, 156 p. [In Russian]

Nessov L.A. 1997. Nemorskie pozvonochnye melovogo perioda Severnoy Evrazii [Cretaceous nonmarine vertebrates of Northern Eurasia]. Saint Petersburg State University, Institute of Earth Crust, Saint Petersburg, 218 p. [In Russian]

Nessov L.A. and Chkhikvadze V.M. 1987. New materials on Paleocene turtles of southern Kazakhstan. *Soobshchniya AN Gruzinskoi SSR*, **125**: 177–180. [In Russian]

Nessov L.A. and Khosatzky L.I. 1977. Freshwater turtle from the Early Cretaceous of Fergana. *Ezhegodnik Vsesoyuznogo Paleontologicheskogo Obshchestva,* **20**: 248–262. [In Russian]

Nessov L.A. and Krasovskaya T.B. 1984. Changes in the composition of turtles assemblages of Late Cretaceous of Middle Asia. *Vestnik Leningradskogo Gosudarstvennogo Universiteta*, **3**: 15–25. [In Russian]

Riabinin A.N. 1938. Some results of the studies of the Upper Cretaceous dinosaurian fauna from the vicinity of the station Sary-Agach, South Kazakhstan. *Problems of Paleontology,* **4**: 125–135. [In Russian]

Rothschild B.M. 1991. Stratophenetic analysis of avascular necrosis in turtles-affirmation of the decompression syndrome hypothesis. *Comparative Biochemistry and Physiology Part A: Physiology*, **100**(3): 529–535.

Rozhdestvensky A.K. and Khosatzky L.I. 1967. Late Cretaceous land vertebrates of the Asiatic region of the USSR. In: Stratigrafiya i paleontologiya mezozoyskikh i kainozoyskikh kontinental'nykh otlozheniy aziatskoy chasti SSSR. Nauka, Saint Petersburg: 82–92. [In Russian]

Semikhatov M.A. and Chumakov N.M. (Eds.) 2004. Klimat v epokhi krupnykh biosfernykh perestroek [Climate in epochs of major biospheric reorganization]. Nauka, Moscow, 297 p. [In Russian]

Shul'ts S.S. 1972. Geologicheskoe stroenie zony sochleneniya Urala i Tyan'-Shanya [Geological structure of the articulation zone between the Urals and Tian Shan]. Nauka, Moscow, 207 p. [In Russian]

Shuvalov V.F. and Chkhikvadze V.M. 1975. New data on Late Cretaceous turtles of South Mongolia. *Trudy Sovmestnoy Sovetsko-Mongol'skoy Paleontologicheskoy Ekspeditsii*, **2**: 214–229. [In Russian]

Shuvalov V.F. and Chkhikvadze V.M. 1979. On stratigraphical and systematical position of some freshwater turtles from new Cretaceous localities in Mongolia. *Trudy Sovmestnoy Sovetsko-Mongol'skoy Paleontologicheskoy Ekspeditsii*, **8**: 58–76. [In Russian]

Shuvalov V.F. and Chkhikvadze V.M. 1986. On the composition and age of deposits of the Ehingol depression in Mongolia and the first findings of fossil turtles there. *Soobshchniya AN Gruzinskoi SSR*, **124**: 433–436. [In Russian]

Shuvalov V.F. and Trusova E.K. 1979. Upper Cretaceous Conchostraca of Mongolia. *Trudy Sovmestnoy Sovetsko-Mongol'skoy Paleontologicheskoy Ekspeditsii*, **8**: 83–94. [In Russian]

Sonoda T. and Hirayama R. 2009. A new trionychoid turtle (order Testudines: class Reptilia) from the Lower Cretaceous of Central Japan. Gaffney Turtle Symposium (17–18 October 2009, Drumheller, Canada). Drumheller, Canada: 169–170.

Sukhanov V.B. 2000. Mesozoic turtles of Middle and Central Asia. In: M.J. Benton, M.A. Shishkin, D.M. Unwin and E.N. Kurochkin (Eds.). The Age of Dinosaurs in Russia and Mongolia. Cambridge University Press, Cambridge: 309–367.

Sukhanov V.B. and Narmandakh P. 2006. New taxa of Mesozoic turtles from Mongolia. In: I.G. Danilov and J.F. Parham (Eds.). Fossil Turtle Research, Vol. 1. Zoological Institute of the Russian Academy of Sciences, Saint Petersburg: 119–127.

Suzuki Sh. and Narmandakh P. 2004. Change of the Cretaceous turtle faunas in Mongolia. *Hayashibara Museum of Natural Sciences Research Bulletin*, **2**: 7–14.

Syromyatnikova E.V. 2011. Turtles of the genus *Ferganemys* Nessov et Khosatzky, 1977 (Adocidae): shell morphology and phylogenetic position. *Proceedings of the Zoological Institute of the Russian Academy of Sciences*, **315**(1): 38–52.

Syromyatnikova E.V. and Danilov I.G. 2008. Distribution of fossil turtles of families Adocidae and Nanhsiungchelyidae in Asia. Otchetnaya nauchnaya sessiya po itogam rabot 2007 g. (8–10 April, 2008, Saint Petersburg). Zoological Institute of the Russian Academy of Sciences: 47–48.

Syromyatnikova E.V. and Danilov I.G. 2009. New material and a revision of turtles of the genus *Adocus* (Adocidae) from the Late Cretaceous of Middle Asia and Kazakhstan. *Proceedings of the Zoological Institute of the Russian Academy of Sciences*, **313**(1): 74–94.

Syromyatnikova E.V. Danilov I.G. and Sukhanov V.B. 2009. Morphology and systematic position of *Adocoides amtgai* – turtles of the family Adocidae from Late Cretaceous of Mongolia. Paleontology of Central Asia. International Conference to 40th Anniversary of the Joint Russian-Mongolian Paleontological Expedition (18–19 November 2009, Moscow). Paleontological Institute, Moscow: 77–79. [In Russian]

Tong H., Buffetaut E. and Suteethorn V. 2006a. *Isanemys*, a new adocid turtle from the Sao Khua Formation (Early Cretaceous) of the Khorat Plateau, northeastern Thailand. In: I.G. Danilov and J.F. Parham (Eds.). Fossil Turtle Research, Vol. 1. Zoological Institute of the Russian Academy of Sciences, Saint Petersburg: 128–137.

Tong H., Claude J., Buffetaut E., Suteethorn V., Naksri W. and Chitsing S. 2006b. Fossil turtles of Thailand: an updated review. In: J.C. Lü et al. (Eds.). Papers from the 2005 Heyuan International Dinosaur Symposium, Geological Publishing House, Beijing: 183–194.

Tong H., Claude J., Suteethorn V., Naksri W. and Buffetaut E. 2009. Turtle assemblages of the Khorat Group (Late Jurassic – Early Cretaceous) of NE Thailand

and their palaeobiogeographical significance. *Geological Society of London Special Publications*, **315**: 141–152.

Tong H. and Mo J. 2010. *Jiangxichelys*, a new nanhsiungchelyid turtle from the Late Cretaceous of Ganzhou, Jiangxi Province, China. *Geological Magazine*: 1–6.

Tong H., Suteethorn V., Claude J., Buffetaut E. and Jintasakul P. 2005. The turtle fauna from the Khok Kruat Formation (Early Cretaceous) of Thailand. In: L. Wannakao et al. (Eds.), Proceedings of the International Conference on Geology, Geotechnology and Mineral Resources of Indochina (GEOINDO 2005). Khon Kaen University: 610–614.

Tsybin Y.I. and Kurzanov S.M. 1979. New data on Upper Cretaceous localities of vertebrates of Baishin Tsav region. *Trudy Sovmestnoy Sovetsko-Mongol'skoy Paleontologicheskoy Ekspeditsii*, **8**: 108–112. [In Russian]

Tumanova T.A. 1983. The first ankylosaurs from the Lower Cretaceous of Mongolia. *Trudy Sovmestnoy Sovetsko-Mongol'skoy Paleontologicheskoy Ekspeditsii*, **24**: 110–118. [In Russian]

Verzilin N.N. 1976. Paleogeography of the Fergana Depression in the Late Cretaceous. *Lithology and Paleogeography*, **2**: 114–132. [In Russian]

Wiman C. 1930. Fossile Schildkröten aus China. *Palaeontologia Sinica*, Series C, **6**(3): 1–56 + Taf. I–VI.

Zachos J.C., Pagani M., Sloan L., Thomas E. and Billups K. 2001. Trends, rhythms, and aberrations in global climate 65 Ma to Present. *Science*, **292**: 686–693.

Zangerl R. 1969. The turtle shell. In: C. Gans, A.d.A. Bellairs and T.S. Parsons (Eds.). Biology of Reptilia, Vol. 1, Morphology A. Academic Press, New York: 311–339.

Submitted December 20, 2010; accepted May 15, 2011.